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ANNALS
OF
SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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Vol. 59 pt. 2

182427
11/7/23

~~VOLUME XLVI~~

~~JULY—DECEMBER, 1907~~

April-June 1914

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ANNALS OF SURGERY

VOL. LIX APRIL, 1914 NO. 4

ORIGINAL MEMOIRS.

THE METHODS SUGGESTED FOR BONE TRANSPLANTATIONS.

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BONE transplantation has become a well recognized and successful surgical procedure. Perhaps no other one thing in surgery has created a greater discussion than the function of the periosteum in bone transplants and what it accomplishes. To understand the subject it will be necessary to give the three views of leading authorities as to the life of grafts:

1. The universally accepted view in Germany is that of Axhausen, who maintains that the bone in a graft always dies, is absorbed and is reformed from the periosteum, which alone remains living in transplants.

2. The second view is that of Macewen, of Glasgow, who says that the bone in a graft is reproduced from the proliferation of osteoblasts, derived from the osteoblasts within the bone of the graft itself, and its regeneration takes place independently of the periosteum, whose only function is that of a limiting membrane, which prevents the spread of the osteoblasts into the surrounding tissues.

3. The third view is that of Murphy, who says that the graft is not osteogenetic but simply osteoconductive. Provided it be in contact at one or both extremities with other living bone, the graft acts simply as a scaffolding for the growth of the capillaries with their osteogenetic cells as they advance from

the living, contacting extremities into the graft. The periosteum takes no part in the actual reproduction of new bone.

To analyze Dr. Murphy's transplantations a little further, I may say that I have gone through all of his reported transplantations with the object of finding out just what was done with the periosteum in each procedure. In a number of cases this was not stated. In all such instances I have ascertained from him in writing exactly what was done with the periosteum. In not a single instance did he omit to transplant grafts with more or less of their covering periosteum. From a practical stand-point I judge that he does not know just what would have happened had he transplanted grafts without their periosteum, so that his conclusions as to the function of the periosteum are conjectural only.

We know that practically every graft made with its periosteum will permanently live, if asepsis be attained. What will happen to grafts made without their periosteum? Following the publication of Macewen's monograph, "The Growth of Bone," in which no osteogenetic power is attributed to the periosteum, I made four human transplantations without periosteum and in every case the graft was ultimately absorbed. That led me to perform a large number of animal experiments, which are published in full in *Surgery, Gynecology and Obstetrics,* Feb., 1914, and in the *Journal of the American Medical Association,* Jan. 31, 1914. Every graft made with periosteum lived. Of 25 grafts made without periosteum but 48 per cent. lived. That led me to conclude that the blood supply of the graft was the all important factor. Since we have no way of knowing in which cases the blood supply will be sufficient, if grafts be without their periosteum, the conclusion seems irresistible that grafts should always be made with periosteum upon them. This will assure subsequent life to practically every graft so made, if asepsis be attained. The conclusions that I formulated, with a proof of each, are as follows (they form a fairly complete set of rules for making transplantations):

1. If a section of the whole diameter of a bone be removed,

then the bone will regenerate between the ends of the fragments, if the whole, or a part of the periosteum, bridging the defect, be preserved. Proof:

Fig. 1. Experiment 3. This animal was killed eight months after subperiosteally resecting a section of a rib. This rib without periosteum was then split into longitudinal strips and these were transplanted into the abdomen. Result: The defect in the rib, from which the periosteum was not removed, has become entirely filled in with new bone. The strips, transplanted into the abdomen have remained intact, have grown together, and have increased in size. A photomicrograph of a section of this abdominal transplanted bone, shows bone perfectly alive, not undergoing absorption, and containing well preserved and normal marrow. I attribute the living of these transplants to the fact that the splitting of the original rib allowed sufficient blood to get to the bone cells.

This is a refutation of Dr. Murphy's conclusion, in which he says that bone, with or without its periosteum, when transplanted into the soft parts and not in contact with living bone, always becomes absorbed. This was one of the cases in which the graft transplanted without periosteum did not become absorbed. I have a number of such experiments.

2. If a section of the whole diameter of a bone be removed, there will take place very little subsequent filling in of this defect by new bone, if the entire periosteum has been removed from between the ends of the fragments. To have such a defect fill in, it is necessary that there shall be left either some portion of periosteum or a thin layer of bone, bridging the defect. Proof:

Fig. 2. Experiment 2. This picture was taken six months after resecting the whole diameter of a rib, together with its periosteum. The defect has not at all closed in, due to the lack of periosteum. The periosteum was stripped bluntly from the bone section and this strip of periosteum was transplanted into the abdomen (*A*). Result after seven months: A transverse section was cut through this periosteum (*A*), which was felt to be bone. A microphotograph of this section gives a picture of normal, healthy, living bone, surrounded by a closely investing, connective tissue capsule. There are no osteoclasts present nor any round cells, suggestive of either a destructive or an inflammatory process.

This result shows that transplanted periosteum may produce living bone, contrary to Macewen and Murphy's opinions.

3. Provided that a graft be living and taken from the same patient, who is to be grafted, its future life depends on an efficient blood supply, irrespective of either the periosteum, or whether the graft is in contact with living bone or not. This conclusion I desire to most emphatically emphasize. The blood supply seems to be favorably influenced by the periosteum, since 100 per cent. are successful with it and but 48 per cent. without it. Hence the teaching is clear to always transplant grafts with periosteum.

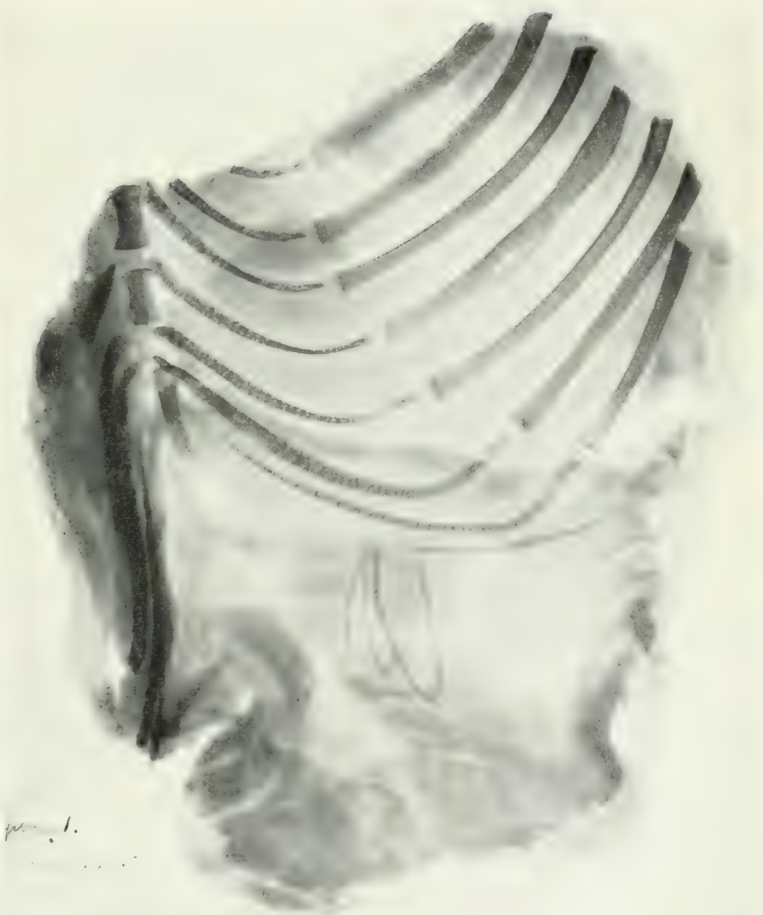
4. If minute fragments of a living graft be transplanted, then the periosteum may more readily be disregarded because the osteoblasts in the fragments may not die because of an easier access of blood to them, and the pieces of bone may grow and coalesce and not become absorbed. My statistics show that 50 per cent. of such procedures will be successful. Proof:

Fig. 3. Experiment 9. This animal was killed five months after one inch of the radius was removed, together with its periosteum. The periosteum was then scraped off the fragment, which was split into as small pieces as possible with the rongeur. The small fragments were replaced, filling in the defect in the radius. Result: The small fragments have all remained alive, have coalesced into one piece, which has become united to the ends of the radius fragments.

This experiment illustrates the influence of a good blood supply upon grafts. See also Macewen's case under " Methods of Bone Transplantation," No. 1.

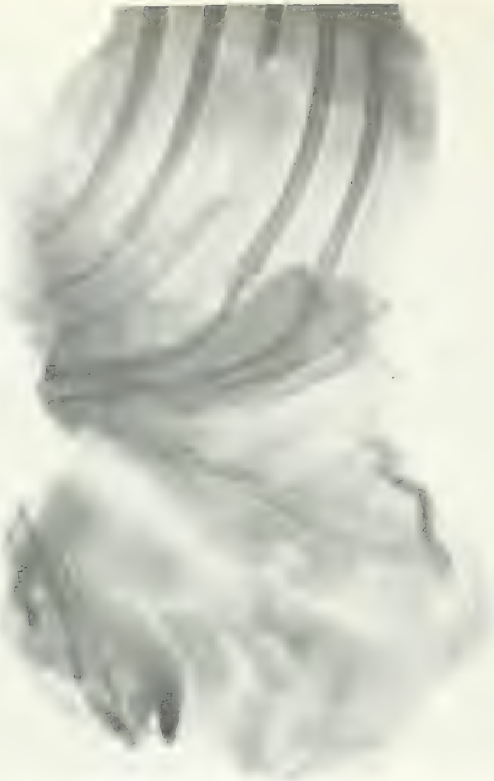
5. If a large piece of living bone be transplanted, then it is much safer to leave the periosteum attached to the graft, in order to be sure of its future re-formation, since otherwise the osteoblasts in the bone of the graft will probably die because cut off from a sufficient blood supply. The periosteum survives because of its adequate blood supply from the surrounding tissues, its inner surface forms osteoblasts, which themselves proceed to re-form the bone of the graft, in the event that the osteoblasts within the transplant itself have died from a deficient blood supply. My statistics show that 41 per cent. of procedures are successful in which large grafts without periosteum are transplanted. Proof:

FIG. 1.



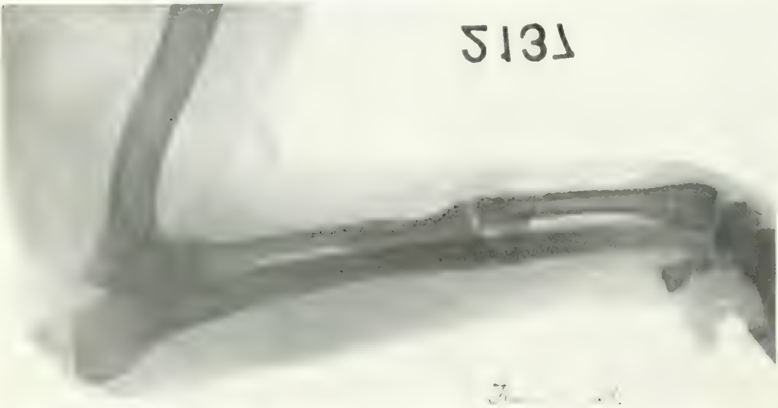
Experiment 3. Strips of a rib without periosteum, transplanted into the abdominal wall, not in contact with living bone, have remained living and have grown together.

Fig. 2.



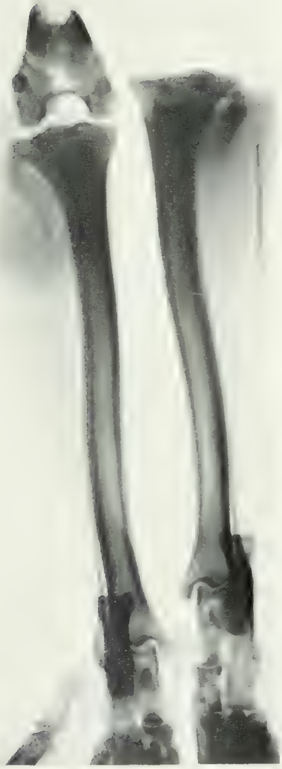
Experiment 2. Strip of periosteum without bone, *A*, transplanted into the abdominal wall, has produced new bone.

Fig. 3.



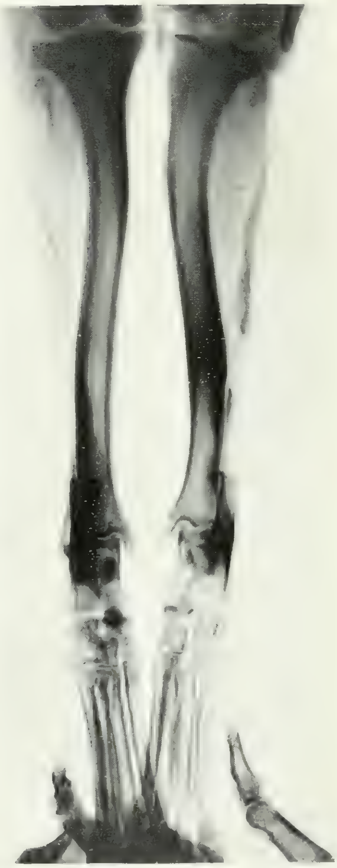
Experiment 9. Small fragments without periosteum, transplanted into a defect in the radius, have lived and have all grown together.

FIG. 4.



Experiment 23. Right fibula without periosteum transplanted into left fibula defect in contact with old stumps has entirely disappeared. Into muscle of right leg was transplanted the left fibula with periosteum. This has remained living, although it was not in contact with living bone.

FIG. 5.



Experiment 26. Piece of periosteum from right fibula section, transplanted into muscles of left leg, has produced new bone. Right fibula segment into left defect without periosteum has disappeared. Left fibula segment transplanted into muscles of right leg with periosteum with no bony contact has remained living.

Fig. 4. Experiment 23. Dog 423. Operation: A section from the right fibula intact without periosteum was transplanted into left fibula defect in contact with old stumps. The stumps of the right fibula defect were covered with muscle, which was sutured over them. Under fascia of right leg was placed the entire section from the left fibula with periosteum still on it uninjured, there being no contact of this graft with living bone. Result 81 days after the operation: The section into the left fibula defect without periosteum has almost completely disappeared. There is a slight line left indicating a persistence of some of it. This disappearance has occurred notwithstanding that it was in contact at both ends with living bone. The difference the presence or absence of the periosteum makes is indicated in the right leg. The section from the left fibula into the right fibula defect with periosteum has remained of its original size and seems perfectly alive, this notwithstanding that it was not in contact with living bone.

This experiment is another evidence that Murphy is not correct in his statement that grafts must be in contact with living bone in order to live. This experiment would also seem to indicate that the periosteum is the important element in maintaining the life of grafts, probably due to its influencing favorably the blood supply.

6. Periosteum alone when transplanted into the soft parts may produce living bone. Proofs: Experiment under conclusion 2, also the following:

Fig. 5. Experiment 26. Dog 426. Sections from each fibula were excised. From the section from the right side, all the periosteum was bluntly stripped off from all its sides in one piece. This piece of periosteum was vertically stretched out under skin of left leg. The bone itself from the right fibula without periosteum was placed in contact with the ends of the old stumps in the left fibula defect. Over the ends of the stumps of the right defect in fibula, muscle was sutured so that the graft would not be in contact with living bone and in the superficial muscles of the right leg was placed the section from the left fibula with its periosteum entire. Result 102 days after operation: The section of bone with periosteum in right leg, not in contact with living bone, has grown to two or three times its normal size and is certainly perfectly alive. The piece of fibula without periosteum into left defect from right fibula has entirely disappeared. This is probably due to the fact that the bone was transplanted entire. Had it been split, as in the preceding two experiments, it more than likely would have survived, due to the consequent better blood supply. The periosteum on the other hand, transplanted under the skin of left leg, has developed a new mass of bone of the size and shape of the old fibula from which it was taken.

7. Contact with living bone is not necessary for the subsequent life and permanency of living grafts, as has been maintained by Murphy: Experiment 26, under conclusion 6, Fig. 5.

8. From a consideration of all the foregoing facts, the conclusion seems irresistible that bone grafts of whatever size should be transplanted with as much periosteum covering their surfaces as is possible, if one is to be positively assured of their subsequent survival. It seems probable that the influence of the periosteum is exerted in maintaining the nutrition of the graft. We must conclude that both Macewen and Murphy are mistaken in their conceptions of the lack of function of the periosteum in maintaining the life of grafts. Murphy must likewise revise his conclusion that the graft is not osteogenetic in itself, that it is simply osteoconductive of cells into the graft from the contacting living bone. I have proved that contact with living bone is not necessary for the permanent life of grafts.

9. Finally, periosteum transplanted into the soft parts may produce new bone.

Indications for Bone Grafting (modified from Murphy, *J. A. M. A.,* vol. lviii, 1912).—1. To correct deformities resulting from defects of development, as aplastic extremital bones—radius, ulna, humerus, tibia, fibula and femur, and congenital and acquired saddle-nose, aplastic mandible, spina bifida, etc.

2. To produce union in ununited fractures. This is the best treatment and much superior to Lane's plate.

3. To replace bone removed by destructive infections, osteomyelitis, tuberculosis, lues, etc., *e.g.,* spina ventosa.

4. To restore or supplant fragments dislodged or destroyed by fractures, as the head of the humerus, head of femur, shaft of tibia, etc.

5. To replace bone removed for non-malignant neoplasms, cysts, myeloma, osteitis fibrosa, adamantinoma of jaw.

6. To replace bone removed for encapsulated malignant disease, as giant cell and chondrosarcoma, etc.

7. To immobilize joints, as, for example, those with too

great laxness or imperfect muscular control, resulting from infantile paralysis or Charcot joint, and for the cure of tuberculosis of joints, as in bone grafting for tuberculous spine (Albee's operation).

General Principles to be Observed in Bone Transplantations.—No cavity which is septic should be filled with transplanted bone as the graft will die and slough out. All wounds should be perfectly healed before transplantation is attempted.

Most scrupulous asepsis is an absolute essential. No graft should be handled by the operator. It should be grasped by instruments and thus inserted in its new bed.

The living graft should be transplanted always with periosteum on it. This is most important.

The graft should be taken living from the same individual who is to receive the transplant. If this be not possible, then it should be taken from as near a relative as possible. Animal bone should not be used, if it is possible to avoid it, because it will be absorbed owing to the changed serological relations. If taken from another individual, the grafting should not be done until syphilis is ruled out by a Wassermann reaction.

When the head of the humerus or femur is fractured and dislocated and the joint is opened, then the head should be replaced and attached to the freshened lower fractured surface, even though the head be dead, provided it is still aseptic.

All foreign non-absorbable material, wires, nails, celluloid, rubber, etc., should be avoided as implants unless under very exceptional conditions. Encircling wires will erode the bone and a fracture may result. These non-absorbable foreign bodies tend to irritate, if not invite suppuration, and often produce sinuses which will usually require their removal to cure the sinuses. Chromic gut should be used to fix the grafts in position, avoiding nails and wires for the above reason, and living bone grafts should be taken from the same patient who is to receive the graft, if possible.

A graft increases in size according to the demands put upon it by the organism. Experience has taught that it is not necessary to fill up completely with a living graft a defect. A much smaller living transplant with its periosteum may be used which will increase to the size necessary. This statement is fixed and settled by many transplantations.

After transplantation absolute immobilization is essential for success. This should be maintained for at least five months, longer if roentgenograms show its necessity.

An Esmarch tourniquet had best not be employed, since it predisposes to subsequent oozing, and blood would be effused about the graft, whose nutrition is thus injured and the tendency to suppuration is increased.

Methods of Bone Transplantation (modified from Binnie). —1, Transplantation of small bone chips with as much periosteum as possible; 2, transplantation of free, non-pedunculated, large fragments, always with periosteum covering at least one side; 3, transplantation with pedunculated bone flaps, the pedicle being either permanent or temporary and the bone taken either from the same bone which is to be grafted or from a neighboring bone; 4, transplantation combined with arthroplasty, implantation of a part of the length and the whole thickness of the shaft of a bone with one articular end; 5, transplantation of periosteal flaps (Codivilla's operation); 6, transplantation for congenital absence of tibia; 7, transplantation of dead bone, either decalcified bone chips or large fragments; 8, transplantation of absorbable or non-absorbable foreign material; 9, transplantation of joints.

1. *Transplantation of small bone chips.* The following is an illustrative case:

Macewen in his book mentions the case of a boy, the whole of whose diaphysis he was compelled to remove for necrosis. There was no subsequent osseous deposition. Fifteen months later he was readmitted with the request by the parents that the boy's useless arm be removed. Two wedges of bone were excised from another patient of six years of age afflicted with anterior curves. These were cut into minute fragments, quite irrespective of the periosteum, and were then deposited into the muscular sulcus in the boy's arm. There was no pus formation. Two months later a portion of new bone, an inch in length and three-quarters of an inch in thickness, was found firmly attached to the upper fragment of the humerus. Here all the grafts proliferated, grew to one another, and also to the extremity of the proximal portion. Two other wedges of bone of larger

> size than the first were similarly dealt with and inserted two months subsequently to the first graft, and a third couple were placed in position five months after the first. These all fused together and to the condyles of the humerus, filled the gap in the arm to the extent of four and a quarter inches. It is now 30 years since the humeral shaft was rebuilt, and during all that period the man has depended upon his physical exertions for the earning of his living. He worked as a joiner for many years, and is now an engineer's pattern-maker.

Macewen also relates the following experiment. This experiment I have myself duplicated with precisely the same result in several dogs but not always.

> The greater part of the shaft of the radius with its periosteum was removed. The shaft of the bone removed, destitute of its periosteum, was then cut into very fine shavings and these shavings were placed between the muscles, which bulged into the gap left in the bone by the removal of the shaft. The neighboring muscles were then attached over the bone shavings in order to keep the shavings in position, and especially to prevent their being extruded from the wound. Examination of the specimen obtained seven weeks after operation showed that the continuity of the shaft was entirely restored. There was a marked increase in the diameter of the shaft opposite the part where the shavings had been inserted. All the component parts had become fused by osseous tissue into one another and both ends of the shaft.

The method of transplanting small chips does not seem to have as great an advantage as transplanting a large single fragment with periosteum for the reason that small chips are less liable to have periosteum on them than large ones, and consequently some of them will die and become absorbed. This I have noticed also by experiment. The teaching seems clear that in simple, comminuted fractures, one should not remove loose fragments, particularly if there be any periosteum on them. They should be replaced, if kept aseptic.

Technic.—Let us suppose the grafting is for ununited fracture, expose the ends of the fragment, remove all fibrous tissue between them and freshen the ends by sawing them off. The favorite bones from which to get the grafts are the tibia, clavicle, rib and upper third of ulna. Tibia is probably the best. Remove from it, as described under the next section, a length of bone sufficient to bridge the defect, with periosteum on one of its sides. With chisel divide this piece of bone into small fragments with periosteum on each fragment if possible. Fill the defect to be closed by these fragments. Close the wound without drainage and immobilize.

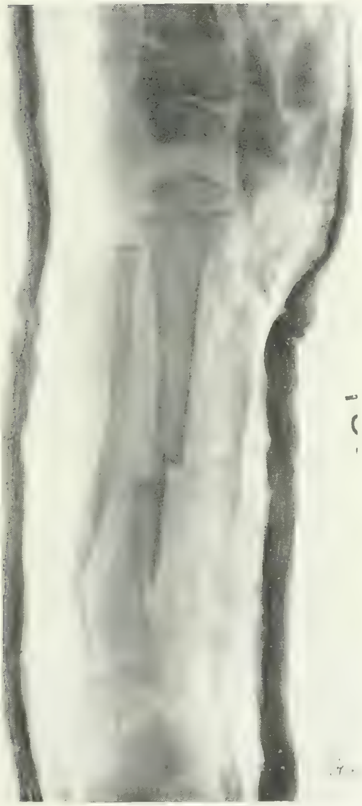
2. *Transplantation of non-pedunculated large fragments, but always with their periosteum.* Success is assured if the periosteum be on the grafts, if asepsis be attained.

The following case is illustrative of free large bone grafts and how important it is to have periosteum on grafts. Two transplantations were performed, the first time, following Macewen's teaching, without periosteum. The graft was absorbed. The second time periosteum was on the graft and the result was perfect.

Case I.—This is an exceedingly interesting case of non-union in a birth fracture of both bones of the leg in a child 17 months old. The non-union I attribute to insufficient immobilization of the leg. I cut down upon the fracture and after freshening the pointed extremities of the fragments, there resulted a defect of an inch and a half in the tibia, which made transplantation of bone necessary. A graft (Fig. 6) from the opposite tibia was chiselled out with its periosteum. The periosteum was then deliberately peeled off the graft with the object of confirming Macewen's view of its unimportance. One end of the graft was pointed and it was wedged into the medullary cavity of the upper fragment, and the lower side of the transplant was spliced to the side of the lower fragment with chromic gut. The subsequent union of the wound was by first intention. The next picture shown (Fig. 7) was taken six months after the grafting. It was very disappointing to see the tibial graft gradually melt away in the tissues, so that, after six months, it was not more than one-quarter its original size. Since union was by first intention, there seems no way of accounting for the death of the graft save on the basis of a lack of periosteum, or of a deficient blood supply, or both.

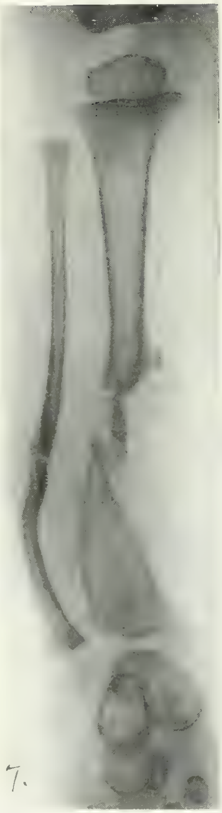
Six months after the previous grafting operation, I transplanted five inches of the opposite healthy fibula into the medullary cavities of the fragments, as is seen in the picture, Fig. 8. It was transplanted with the periosteum covering its entire circumference and this was not split in the slightest. The result shows that this splitting of the periosteum on a graft is entirely unnecessary

Fig. 6.



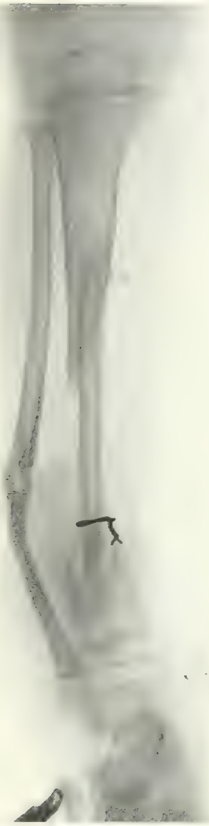
Human transplantation. Graft without periosteum into tibial defect.

Fig. 7.



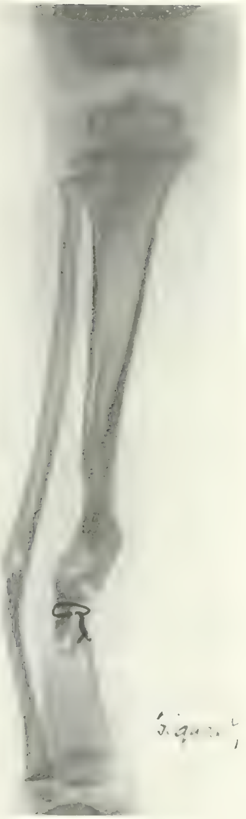
Same patient after six months. Graft is disappearing.

Fig. 8.



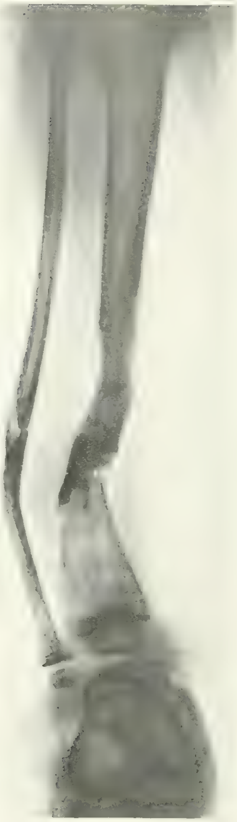
Same patient after second transplantation. Into the medullary cavities of the tibial extremities was inserted a section from the same patient's opposite fibula with periosteum on all sides.

Fig. 9.



Same patient six months after the second transplantation. The graft has increased enormously in size, but it has been fractured, with the production of an enormous callus. The fracture is healing nicely. The wire is eroding the graft.

Fig. 10.



Same patient four months after the removal of wire. Fracture has healed and the lower part of the graft is developing.

and accomplishes nothing. Below a wire encircling suture was used to hold the graft in place.

Fig. 9 was taken six months after the transplantation. To my mind it seems to imply the necessity of revising Dr. Murphy's conclusion that a graft is not osteogenetic in itself. A fracture has taken place in the lower third of the transplant, due to the fact that the child kicked off the splint one night. We see that the upper portion of this fracture of the graft itself is consolidating nicely under an enormous callus. If we accept Dr. Murphy's conclusion, we must believe that all this callus came through the graft from the contacting old bone of the neighboring stumps. I do not accept this view for a moment, but believe that the callus arose either from the periosteum or from the bone of the graft itself. Along the outer surface of the graft we see at least a quarter of an inch of new bone evenly distributed. Were this new bone formed from the contacting ends of the old bone of the stumps, it seems to me that it would shade off, becoming less the further we went from the old bone. As a matter of fact, the greatest amount of new bone is at the fracture spot in the graft, which is at some distance from either contacting extremity of old bone. The lower fragment below the fracture, due to the inhibitory influence of the wire, has scarcely developed at all and it is being eroded by the wire. On June 9, 1913, I removed this wire, when the lower fragment started immediately to develop. Fig. 10 was taken four months after the wire was removed. The fracture is healed and the callus has disappeared. Consolidation is progressing nicely between the lower end of the lower fragment and the upper end of the lower shaft.

Technic.—Let us take, for example, an ununited fracture. Bone grafting is the operation of choice in such a condition. Expose the ends of the fragments, remove all fibrous tissue from between them and freshen the ends by sawing off sections. The bone graft may be chosen from the tibia, rib, upper third of ulna, clavicle or crest of ilium. If the rib be chosen, periosteum should be taken covering half its surface, so as to avoid opening the pleura. The tibia is the easiest and the most frequently employed bone from which to get the graft. A curved incision through the skin is made beginning at its anterior border with the convexity nearly at the posterior border, ending below at the anterior border again. The flap of skin is reflected off the periosteum beneath. A wide thin carpenter's chisel is as good an instrument as any to make the graft and there is no need of a more complicated circular motor saw. Measure the length of defect to be filled in and add to this sufficient length to dovetail each end into the corresponding medullary cavity of the fractured ends. With the chisel make transverse cuts at the anterior border of the tibia at each end of the part to be transplanted, one-half or three-quarters of an inch deep, the transplant being about as thick as one's forefinger. On the internal surface join the posterior end of each transverse cut by a longitudinal groove which is made by successive light blows of the mallet on the chisel directed outward, which is moved along after each blow. This is to prevent splintering of the graft. Proceed deeper, the chisel being moved along the groove after each blow. By a longitudinal incision divide the tibialis anticus from the external surface of the tibia without injury to the periosteum, which is longitudinally incised at a distance the same as on the internal surface. Join the posterior ends of the transverse incisions in the bone by a longitudinal groove made on the external surface, the chisel being directed inward through the incision in the periosteum. Proceed deeper until the chisel enters the medullary cavity, then go to the opposite groove and carry this likewise into the medullary cavity. The graft is lifted out by an instrument and is never touched by the gloved hand. The graft should be placed into the defect made for it just as quickly as possible that its cells may not die from lack of nourishment. It should not be placed in salt solution as this washes away the little blood that is left on the graft to nourish its cells. Murphy's method is to enlarge the medullary cavities of the fragments with a reamer or burr for a distance sufficient to form a good firm bed for the graft. An equally good method is to make longitudinal furrows opposite to each other on the stumps, large enough to receive the graft. Drill holes are made through the fragments and graft and chromic gut sutures are inserted through them and tied. Murphy prevents the graft from riding up the medullary cavity by inserting a nail through the fragments and graft, but it seems wise not to use any foreign body which may later irritate. It is not necessary for apposition to be maintained between the ends of the fragments of the fractured bone though this is desirable. In this way can be overcome the shortening of the extremity. The graft has periosteum on two of its surfaces and medullary tissue on the other and will positively live if asepsis be attained. Both wounds are closed without drainage and the fractured limb is immobilized.

Bittner resected the lower half of the shaft of the tibia for sarcoma, leaving the lower epiphysis. He filled the gap by splitting longitudinally the remaining half of the shaft up into the tuberosity, turning the segment down and fixing it in place. Only 1.5 cm. shortening resulted and the leg was strong and useful.

Sievers (*Beitrage zur kl. Chir.*, vol. 85, Heft 1) reports having excised the mid-phalanx of the ring finger with its periosteum for sarcoma. He filled this defect by excising the first phalanx of the fourth left toe and transplanting this into the finger defect. The toe defect was filled by a graft from the tibia.

Witzel (*Deut. Zeit. f. Chir.*, Bd. 121, H. 1, p. 180) reports two successful cases in which he substituted a part of the clavicle, resected for sarcoma, by the spine of the scapula.

Pels-Leusden (*Chir. Operationslehre*, p. 222) says that spina ventosa should be treated by excision of the diaphysis with its periosteum and the defect should be filled in with a graft taken from the tibia with its periosteum.

3. *Transplantation with pedunculated bone flaps, either temporary or permanent.* This method is mentioned for the sake of completeness. It is a great question whether it has any advantages over free bone transplants which are uniformly successful if periosteum be on the graft, and if asepsis be attained. Certainly the conditions will be rare in which pedunculated bone flaps are required.

A. Ollier's operation *par renversement.* Expose the ends of the bone and excise the fibrous tissue between them. With a fine saw cut from one fragment a thin triangular slice of bone after freshening the opposite end. The slice of bone is hinged by the periosteum at the other end of the saw line. The triangular wedge of bone is now turned downward and its apex is sutured with chromic gut to the raw bone surface below, or it can be pushed into the medulla. As much as two inches of bone may be replaced by this method. The periosteum is the permanent pedicle.

B. Ollier's operation *par glissement*. Freshen the end of each fragment and remove the fibrous tissue. From the upper end cut a triangular piece of bone with periosteum on it, but do not separate this portion of bone from its connections with the soft parts. Slide this piece of bone downward and suture it to the end of the lower fragment.

C. Ollier's operation of implantation. This is only suitable when one of two parallel bones is the site of a defect. The sides of the ends of the fragments are obliquely vivified opposite the bone from which the transplant is to be taken. These surfaces make two sides of a triangle. From the opposite healthy bone a triangular piece of bone is cut which retains its connections with the soft parts. The graft is turned and implanted into the defect, where it is sutured.

D. Muller's two operations. The first is made by turning the flap which consists of skin, periosteum and bone, the pedicle being permanent. The ends of the fragments are exposed by a vertical incision which projects upward and downward, covering half an inch of the surfaces of each fragment. Remove all scar tissue interposed and freshen the ends and sides of the bone with a chisel. On the surface of the upper fragment outline a tongue-shaped flap, cutting through the periosteum with the knife. The pedicle consisting of skin is off to one side. With a chisel introduced through the upper flap incision cut a slice of bone corresponding to the skin incision. Rotate this flap so that it bridges the osseous defect and fasten the bone in the flap to the raw surfaces of the fragments with chromic gut. Undermine the edges of the upper defect so as to bring them together, or close it by Thiersch's grafts.

The second method by Muller is one in which the twisting of the pedicle is avoided. Make a V-shaped incision, the open part of the V being about two inches below the end of the lower fragment and projecting upward the same distance in front of the upper fragment. Carry the incision through the periosteum below and raise a slice of bone with the chisel from in front of the lower fragment. Elevate the flap, expose the defect between the fragments, remove the fibrous tissue, vivify with the chisel the ends of the bones and the front of the upper fragment. Carry the incision upward through the skin only on the surface of the upper fragment and loosen this part of the flap. Draw the flaps up until the bone in the flap bridges the defect between the upper and lower fragments. Suture the bone in this position. Carry the incision upward until the redundant portion of the upper part of the flap can thus be smoothed out. Undermine the edges of the lower defect and bring them together or Thiersch graft them. This operation has given Muller, Sprengel, von Eiselsberg splendid results.

These operations are not of frequent applicability. If the defect be over 4 or 5 cm. they will be impossible. An objection which strikes me is the increased liability to infection, owing to the Thiersch grafts, or to tension of the sides of the defect, as well as to the small raw surfaces which are liable to be left at the sides.

Vulpius has cut a transplant from one of the fragments with a pedicle solely of periosteum, situated very near the pseudarthrosis. He then turns the graft 190° around on this pedicle and fixes it to the other fragment. A musculo-aponeurotic flap has been used, obtaining the transplant from a neighboring bone. Codivilla has transplanted a graft taken from the iliac crest upon the femur, twisted about a pedicle, taken from the gluteus maximus; and upon the humerus a graft taken from the external border of the scapula, nourished by a part of the external rotators of the shoulder. Bardenheuer in two cases has transplanted the spine of the scapula upon a pseudarthrosis of the humerus. These procedures seem complicated and unnecessary.

Hahn or Huntington's operation. This is suited to patients in whom there has been an extensive loss of tibia but the fibula remains intact. Through an appropriate incision (curved, across the leg at the level of the upper fragment), expose the under surface of the upper fragment and vivify it. Cut the fibula off at this level and insert its end into the under surface of the tibial upper fragment where it is fixed. Six months later, a second operation is done. Expose and vivify the upper surface of the lower fragment of the tibia. Divide the fibula at about the same level and unite its lower end to the fresh surface of the tibia. In some cases both operations have been done at one sitting.

A graft increases in size according to the demands put upon it. This is seen in the case of the above transplanted fibula which eventually increased in size to that of the tibia.

Bardenheuer in a defect in humerus made a tongue flap on chest. Subperiosteally resected a rib which was left attached to flap which was reflected into defect. Division of the bridges in two months. Good union.

4. *Transplantation combined with arthroplasty.* Rovsing excised a sarcoma from the upper end of the humerus and implanted a segment of the fibula. He excised the diseased bone from the humerus together with its periosteum and muscular attachments. He then exposed the upper end of the fibula through a longitudinal incision, retracting out of the way the uninjured external popliteal nerve. The superior tibiofibula articulation was opened and the ligaments divided. The fibula was then mobilized for a distance of 3 cm. longer than the segment of humerus which was removed, by cutting the muscles arising from it, leaving a muscular sheath, about 1 cm. thick, attached to it. The lower end of the fibula fragment was sharpened with a chisel and this was forced into the medullary cavity of the remaining diaphysis of the humerus. Sutured the remains of the articular capsule of the shoulder-joint about the upper end of the fibula and the soft parts of the arm to the muscular tissue left attached to the transplanted fibula.

Walther and also De Gouvea each resected the inferior extremity of the radius for sarcoma. Into the resulting defects each transplanted the superior extremity of the fibula with its periosteum, the head of which was placed in contact with the carpus. Intermedullary fixation of upper end of graft. Result in each case was splendid.

5. *Transplantation of periosteal flaps* (Codivilla's operation). Codivilla, after freshening the ends of the bone, unites them with a wire suture and envelops this suture with a free, detached flap of periosteum taken from any convenient bone, taking pains to shave off with the periosteum a thin shell of bone, but Brade used the periosteum alone and obtained a good result. It would seem to the author better to use an absorbable suture such as large chromic gut rather than wire between the bones. The internal surface of the tibia is a good location from which to get the periosteum. A thin slice of bone should be taken with the periosteum and attached to it.

6. *Transplantation for congenital absence of tibia.* Halsted Myers (*Med. Record,* July 15, 1905) operated as follows: The entire tibia was wanting but the fibula was intact and in its proper position. The outer half of the joint was incised, opening the articulation between the fibula and femur. The patella ligament, thin and strong, was found to be inserted into the inner side of the fibula well below the head. The external lateral ligament was divided. The head of the fibula was drawn down and into a position between the condyles. The patella ligament was shortened and attached to the anterior surface of the fibula. The articular capsule was sutured so as to aid in holding the head of the fibula in its new position. The wound at the knee was closed, after which the ankle was opened by a transverse incision, the external malleolus was cut off and the raw end of the fibula was planted on to the upper surface of the astragalus which was freshened by the chisel to receive it. The bones were sutured together. Immobilization. A year after the operation, the patient could flex his leg to 90°, almost fully extend it, and walked about all day.

7. *Transplantation of dead bone, either decalcified bone chips or large fragments: Senn's decalcified bone chips. Preparation of the chips.* Remove all periosteum and medullary tissue from the fresh tibia or femur of the ox, divide into longitudinal strips about ⅛ of an inch wide and immerse in a relatively large quantity of 10 per cent. watery solution of hydrochloric acid which should be renewed daily, for from one to two weeks; then wash thoroughly in water or a weak solution of caustic potash, cut into small chips, soak for forty-eight hours in 1 to 1000 mercuric bichloride solution, remove and store in a saturated solution of iodoform in ether. When about to be used, wrap in aseptic gauze, dissolve out the excess of ether and iodoform with alcohol and put in 1 to 2000 mercuric chloride solution until required, when careful drying with iodoform gauze should precede their implantation.

Technic.—Fill the cavity completely or the defect between the ends of bone whose extremities have been previously freshened with the chips and allow blood to fill up the interstices between the chips. It is claimed that the bone chips strengthen the framework of blood-clot into which the healthy granulation tissue penetrates, while the iodoform disseminates through the blood clot which thus inhibits bacterial activity (?).

Transplantation of large fragments of dead bone. This method has given some successes.

Kausch, after removing the upper end of the tibia for sarcoma, implanted a corresponding portion of the tibia obtained some days previously in the course of an amputation. The implant was deprived of its periosteum and marrow, was carefully boiled and soaked in ether to remove its fat. An amputation, nine months after the transplantation, for recurrence of the sarcoma, showed the implant firmly united both to the femur and tibia and enveloped in a new formed periosteum. Kuttner excised the upper third of the femur for sarcoma and at once implanted a similar portion of the femur, obtained from a man who died of coma, due to tumor of the brain. The upper end of the femur along with its head was removed under aseptic precautions, eleven hours after death, and was preserved for twenty-four hours in salt solution, to which some chloroform had been added. Six weeks later the result was promising. Brewer, of New York, removed the entire lower third of the radius with its periosteum for sarcoma. A few days later a suicide was brought into the hospital, where he died. The corresponding radius was dissected out, of just sufficient length to fill the defect. This bone was then boiled and kept for several days in sterile salt solution, when the original wound was reopened and the graft was implanted. The soft parts were sutured around it. Union was by primary intention. Several months afterward the transplant showed a moth-eaten appearance, as though it were absorbing. One year later the man had a very useful forearm and hand. At the junction of the graft with the old shaft there was some bowing but union was solid. Roentgenograms showed that the old graft had largely become absorbed but that it had been replaced by new firm bone. The result was very satisfactory.

How many non-successes have followed this method, no one can say. Surgeons are not inclined to publish their non-successes, hence the investigator can scarcely arrive at an unprejudiced judgment of the true value of any particular method.

A better method for the above would seem to be as follows: Walther (*Bull. et mem. de la Soc. de Paris,* vol. 37, No. 20) resected the inferior extremity of the radius for sarcoma similar to Brewer's case above. Into the defect he transplanted the superior extremity of the fibula with its periosteum, the head of which was applied on the carpus. Intermedullary fixation of upper end of graft. Result was fine.

De Gouvea (*La Presse Medicale,* July 17, 1912) performed an exactly similar operation to the preceding with a successful result.

8. *Transplantation of absorbable or non-absorbable foreign material. A.* Non-absorbable material. Murphy and numerous German surgeons have implanted into a defect in the lower jaw made for the removal of malignant tumors, a silver wire model with a metal head of normal size and shape of the mandible. In Murphy's case suppuration occurred around the frame-work, since it communicated with the mouth, and a profuse discharge was present for six weeks, when it ceased entirely. The sinus healed and the frame-work became completely imbedded. Three years later there was no sinus present and the function was good. Because of its vascularity

and resistance to infection, the mouth and face offer the best field for its use. In other parts of the body, sinuses may form which will persist, requiring the removal of the foreign material.

B. Absorbable foreign materials such as ivory, magnesium plates, tubes, or columns have their uses in but a few situations in the body and can usually to advantage be replaced by living bone grafts taken from the same patient who is to be grafted.

Primrose implanted an ivory peg of suitable size and shape into a phalanx removed for a central enchondroma. Fourteen weeks later a roentgenogram showed the peg partially absorbed but surrounded by a satisfactory amount of bone. Possibly a better method would be to remove a phalanx from the patient's toe with its periosteum and transplant that, or else a small piece from the tibial crest with its periosteum.

9. *Transplantation of joints.* In bony anchylosis of the elbow, Buchmann (*Zentralbl. für Chir.*, 1908, No. 19) has devised what may be a valuable procedure. In two cases he transplanted the first metatarsophalangeal articulation into the elbow-joint. His procedure is as follows: A posterior longitudinal incision is made down to the triceps tendon and the olecranon. Divide all the soft parts longitudinally along the outer side of the olecranon. With an elevator, separate and push inward the triceps tendon, remnants of capsule and periosteum. Divide the olecranon at the level of the joint and the lateral remnants of the capsule. Divide the bony union between the humerus, radius and ulna. Flex the elbow and cut out from the trochlea a niche, wider in front than behind and narrower above than below. Remove a very thin slice from the lower end of the humerus. Separate the brachialis anticus from its insertion into the coronoid process. Cut a quadrangular niche in the ulnar epiphysis. Remove the head of the radius and separate the radius from the ulna. Excise the first metatarsophalangeal articulation without opening the joint itself. Remove with the joint sufficient of the metatarsus and phalanx to fit into the niches cut in the humerus and ulna. Implant the excised joint into the wound at the elbow in such a manner that its plantar surface faces backward. Fit the ends of the metatarsus and the phalanx into the corresponding niches cut in the humerus and ulna. Close the wound in the elbow, sewing all divided tissues back into their original normal positions. Immobilize in the extended position.

LEXER (*Archiv. f. kl. Chir.*, vol. 86, p. 852), in 1908, described two cases in which he transplanted the entire knee-joint. The difficulty in obtaining a knee-joint to transplant will undoubtedly prevent the surgeon from frequently imitating this procedure. Lexer warns against obtaining a knee-joint from a cadaver since, in one of his cases, there was so great a formation of connective tissue, that the graft had to be removed on account of lack of motion. The graft will have to be obtained from a freshly amputated extremity, removed for senile gangrene (without phlegmon) or for paralysis. Those interested should consult the original article.

AUTOGENOUS BONE GRAFTING FOR FRACTURE OF THE PATELLA.

BY JOHN ROGERS, M.D.,

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THE usual method of treatment for these injuries consists in exposing the fragments and uniting them by absorbable or non-absorbable sutures. The advantages of absorbable or non-absorbable suture material seem still debatable, with opinion more in favor of chromicized catgut or kangaroo tendon than of bronze or silver wire.

The degree of separability of the fragments depends upon the amount of laceration of the capsule and fibrous tissue in continuity with the line of fracture. Unless these lacerations are repaired when the fragments are sutured, muscular contraction may interfere with bony union no matter what material is used to hold the bones in apposition, and no matter how carefully clots and fibrous fragments are removed from between the bones.

A not uncommon accident after operation in spite of every precaution, is a refracture from apparently insignificant violence. Fibrous union with separation of the fragments and greater or less disability in the injured extremity is probably a more frequent bad result.

To remedy either of these conditions it is suggested that an autogenous bone graft be taken from the crest of the patient's tibia and implanted on the front of the patella to bridge the line of fracture. Similar treatment is applicable to certain fractures of the olecranon.

Operation to Relieve Disabling Fibrous Union of the Patella, or to Cure "Refracture" of the Patella.—Make a U-shaped flap, with the apex of the convexity over the ligamentum patellæ and the extremities over the condyles of the femur, suture the lateral rents in the fibrous capsule. Denude the anterior surface of the patella fragments of periosteum over an area about one inch square on each side of the line of fracture. Expose the crest of the tibia and chisel off from its inner surface a quadrilateral plate 1½ inches long by ¾ inch wide by ⅛ inch thick. Leave its periosteum undetached.

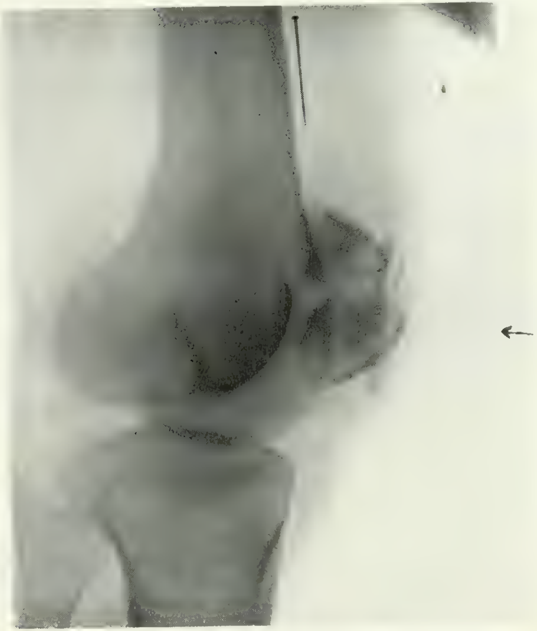
Place this with its raw surface in apposition with the denuded area in front of the patella. Unite the fragments by a figure-eight suture of chromicized catgut or kangaroo tendon, which grasps the ligamentum patellæ and quadriceps tendon immediately below and above the broken bone and crosses in front of the transplant. The periosteum, which was previously turned back from the patella, is next drawn up to, or over, the transplant with a couple of catgut sutures. The skin incisions are closed by a subcuticular catgut stitch, and the limb enclosed in a plaster-of-Paris case splint for four or five weeks.

CASE I.—*"Refracture" of the patella.* Miss A. L., age thirty-four, fell down stairs and sustained a fracture of the right patella on November 1, 1912. I sutured this in the usual way in St. Francis Hospital on November 4, 1912. The splint was worn eight weeks and there was an apparently perfect result.

On February 10, 1913, she slipped on some ice and, without falling, felt something snap. She then walked to the Hospital and the patella was found to be fractured exactly as before. On February 17, under ether the operation described above was carried out. The suture material to retain the bones in position was chromicized catgut. The case splint was worn subsequently for only four weeks. Complete flexion of the joint was possible at the end of about nine weeks. The radiographs show the transplant at the end of three weeks, six weeks and thirty-two weeks (Figs. 1, 2 and 3).

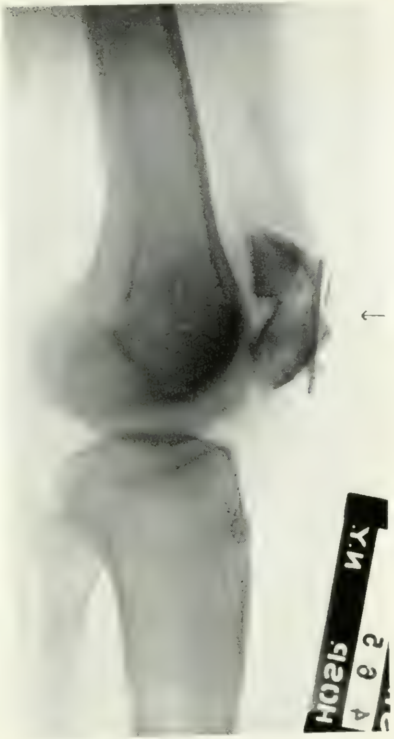
CASE II.—*Ununited fracture of the patella.* Mr. L. S. age forty-four, sustained a fracture of the left patella (by muscular violence) on January 22, 1913. It was treated only by strapping and immobilization for six weeks. He then entered Bellevue Hospital for relief of the weakness in the leg. He was unable to raise the foot from the bed while in a horizontal position. There seemed to be a weak band of fibrous tissue between the fragments which were one inch apart.

FIG. 1.



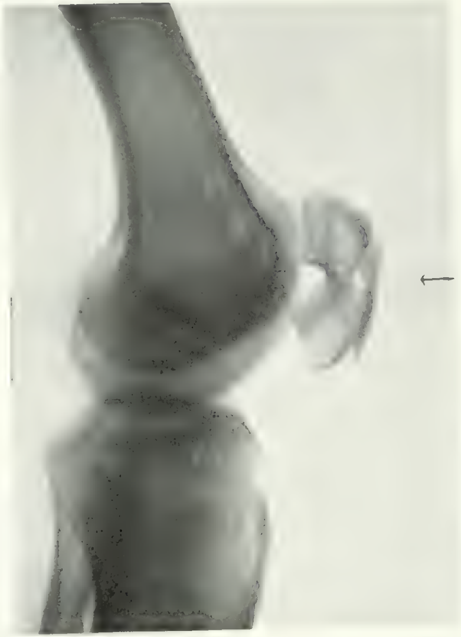
CASE I. A. L. Refracture of patella. This occurred February 10, 1913, and the bone graft was inserted February 17. Radiograph taken March 15, 1913.

FIG. 2.



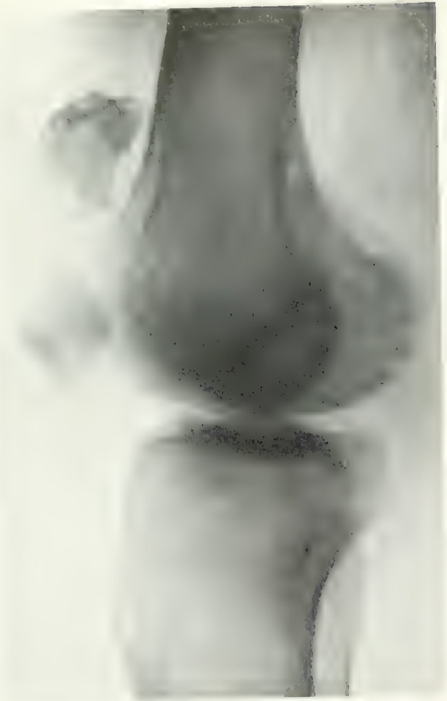
CASE I. A. L. Taken April 5, 1913.

Fig. 3.



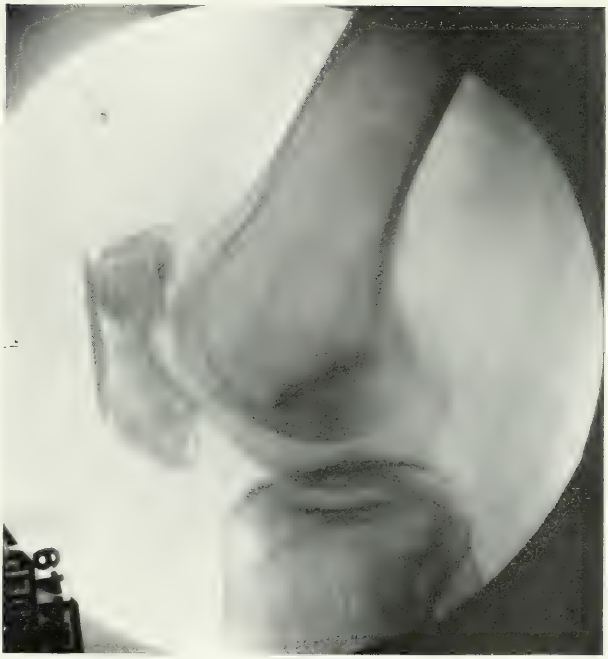
Case I. A. L. Taken October 6, 1913.

Fig. 4.



Case II. L. S. Ununited fracture of patella. This shows the position of the fragments six weeks after the injury, on admission to Bellevue Hospital.

Fig. 5.



Case II. L. S. Showing the autogenous bone graft in position August 1, nineteen weeks after its insertion. There is a perfect functional result.

On March 19, 1913, under ether, the operation described above was carried out. The upper fragment was bound close to the femur by much fibrous tissue, which required very free division before the loosened bone could be brought even near to the lower fragment. Complete contact could not be secured. The suture material to retain the bones in position was chromicized catgut. A case splint of plaster of Paris was worn for six weeks. The result has been perfect restoration of function. The radiographs (Figs. 4 and 5) show the transplant nineteen weeks after its insertion.

THE TREATMENT OF UNUNITED FRACTURES OF THE TIBIA BY THE TRANSPLANTATION OF BONE.

BY M. S. HENDERSON, M.B. (Tor.),

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Mayo Clinic.

UNUNITED fractures of the tibia are relatively common, especially in the middle and lower third of the bone. It is true that we do not see cases of such long duration as those of ununited fractures of the humerus which may be of five and ten years' standing. In one case, recently operated on in the Mayo Clinic, the humerus had been ununited for fourteen years. An arm thus partially disabled is infinitely more useful than an artificial arm and is not, therefore, sacrificed. On the other hand, an ununited fracture of the tibia necessitates the use of crutches or, for a laboring man, complete cessation of work. In such cases an artificial limb is more useful and therefore the legs are sometimes amputated.

The ingenuity of the surgeon has been greatly tried in the treatment of these cases. Many procedures have been advocated, prominent among which, of late years, have been the silver wire and the metal plate. The plate is best suited for certain recent fractures in the tibia in which apposition of the fragments cannot be maintained in any other manner. A perfect anatomic reposition of the fragments is not essential for excellent function. A little displacement is permissible if the axis of the line of weight-bearing in each fragment is parallel, but weight-bearing through an angle is bad, particularly if the fracture be near the joint.

Transplantation of bone into the tibia gives excellent results and the method herein described is so simple and reasonable that it must inevitably supersede the use of the plate or other mechanical devices in the majority of cases.[1]

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[1] In describing this method the author makes no claim for originality. Others have used practically the same procedures. Buchanan published an article and reported a case (*International Journal of Surgery*, October, 1912).

It was noted in these cases that the fibula when fractured had united. If these patients have been previously operated on or if there is much laceration of the skin at the time of the accident, the difficulties in operating are greater. This scar which is closely adherent to the bone, poorly nourished and deprived of subcutaneous tissue, is liable to slough after being lifted up, a complication which occurred in two of our cases. No infection followed but careful dressings were necessary after the slough had separated until healthy granulations appeared.

In the treatment of cases of ununited fractures, enough bone for transplantation can be obtained from the same leg, thereby greatly shortening the patient's stay in bed. The transplanted bone will live if the following conditions are fulfilled: (1) The observation of asepsis; (2) if bone be obtained from the same individual; (3) securing a free supply of blood in the new habitat; (4) maintaining a reasonable amount of bony contact.

This procedure is not recommended for the infected case, although some surgeons have transplanted bone with infection present and obtained good results. When infection is present the bone to be transplanted should first be removed from the other leg and all work completed on this leg before the infected member is touched.

The question here arises: When are we to transplant bone for fractures which have not united? Robert Jones[2] speaks of the condition as " delayed union." This is a better nomenclature than " non-union " since it is probable that all of these fractures would unite in time. However, with the present-day advantages of surgery an operation for this condition may be advised, thereby saving time for the individual and an earlier return to his wage-earning capacity.

There can be no definite period assigned for transplanting bone in these cases of delayed union. Many factors should be considered, but the chief aim of the surgeon is to restore the individual to his duties at the earliest possible period.

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[2] *Amer. Jour. Orthop. Surg.,* October, 1913.

There is generally but little deformity in the fractured tibia and good alignment and position may usually be maintained by the aid of plaster-of-Paris casts or splints. It is difficult to understand why union should not take place in these cases. The type of cases under consideration in this paper does not include the so-called Pott's fracture. Here it is true that the tibia enters into the question, but non-union rarely results and these patients usually seek relief because of faulty alignment which so intimately involves the ankle-joint as to demand correction.

The 9 cases herewith reported were all healthy young males —one a boy 8 years of age. Syphilis was present in but one, and this was contracted after the leg had been broken one year. In the series of 9 cases, 6 were simple fractures and 3 were compound fractures. One of the latter had become infected. The other two, although the bones protruded at the time of the accident, had healed without any signs of infection. It does not seem probable that infection had any bearing on the delay in union.

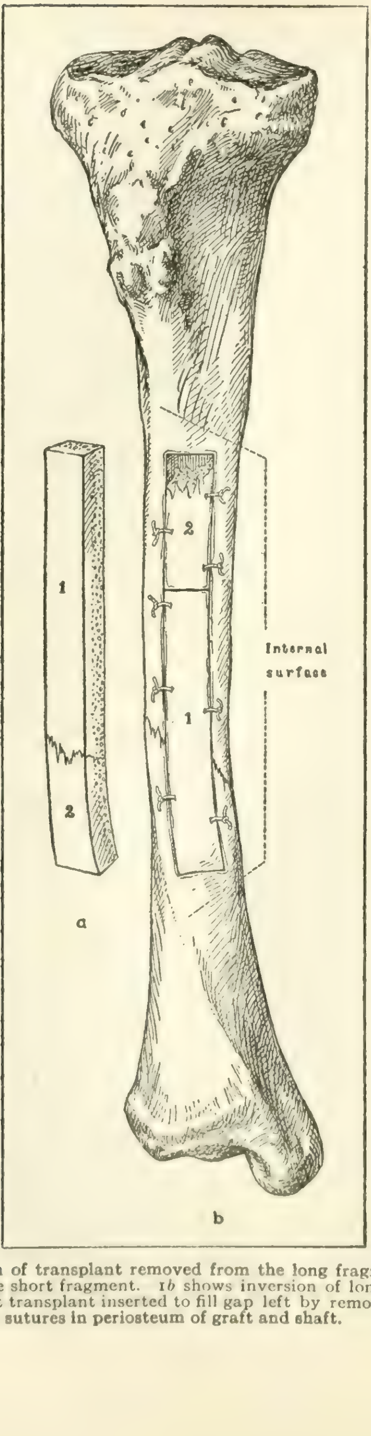
The bone in these cases is especially adapted to transplantation since it is easily accessible, the operative field being just beneath the skin. The transplant will not have to hold the alignment because this can readily be done by external means. The fibula, which is intact or firmly united, maintains the length of the limb and no slipping-by of the fragments is likely to occur. The transplanted bone may be placed in a normal field; it is not necessary to put it in the medullary cavity. A gutter is chiselled or sawed in the fragments down to the medulla, thus allowing the transplant to have a natural bed to rest in. If a piece of cortical bone is used as a medullary plug it acts merely as a foreign body. It is, however, an absorbable foreign body and gradually disappears. During its absorption, osteogenesis is promoted, which leads to union. In operating on cases of ununited fractures of the humerus, 25 years ago, C. H. Mayo used an ordinary cataract bone knife-handle to make an intramedullary plug. He fastened linen sutures to its centre, leaving long ends, and brought these out through the wound. These sutures were tracted every day, thus causing a little motion of the plug. In this way, a mild irritative osteitis was kept up which was conducive to osteogenesis and the formation of callus. This ivory plug usually healed in, but occasionally disintegrated and came out in small pieces.

If transplants are taken from the opposite tibia, patients must be kept off their feet for a month or more. It is much simpler to take the bone from the same tibia, either above or below the fracture and get our patients up within a few days. The bone should preferably be taken from the flat internal surface of the tibia rather than from the crest which is dense, strong, and being the apex of a triangle, serves a most important weight-bearing function. A piece of bone removed from here down to the medullary cavity weakens the bone out of all proportion to the size of the piece removed. The bone on the internal surface is not so dense and is also more vascular and a large piece may be removed here without greatly weakening the bone. All the layers, *i.e.,* periosteum, cortex and medullary lining, should be included in the transplant.

In studying these pieces of transplanted bone by a series of X-ray pictures after their implantation, it is apparent that they live and functionate without being replaced by new bone. In the tibia, by forming a gutter down to the medullary cavity, the transplant can be placed so that periosteum meets periosteum, cortex meets cortex and medullary lining meets medullary lining, thus obtaining an anatomic approximation favorable to rapid healing.

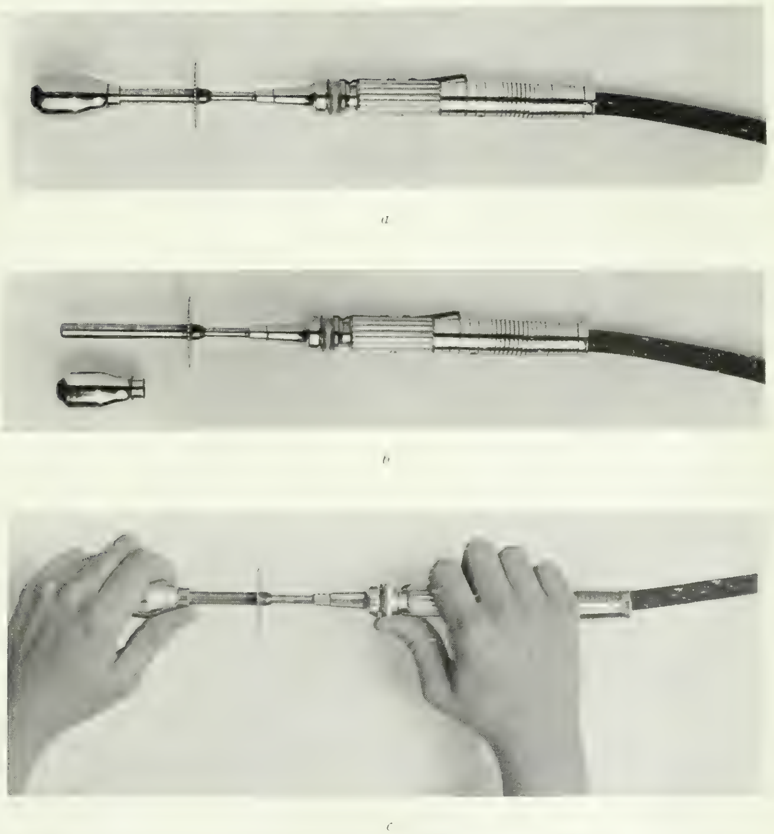
The technic of the operation, as followed in our more recent cases, is simple and may best be shown by the diagram (Fig. 1). Either by the aid of the chisel or the motor-propelled circular saw (Fig. 2), a piece of bone is removed from the internal flat surface of the tibia. The bone should be of sufficient length to make a substantial bridge, usually 2 or 3 inches long and about ½ inch in breadth, and should include all the layers. This is taken from the longer fragment. A piece the same width in the same line is then removed from the smaller fragment. This is saved. The larger piece of trans-

FIG. 1.



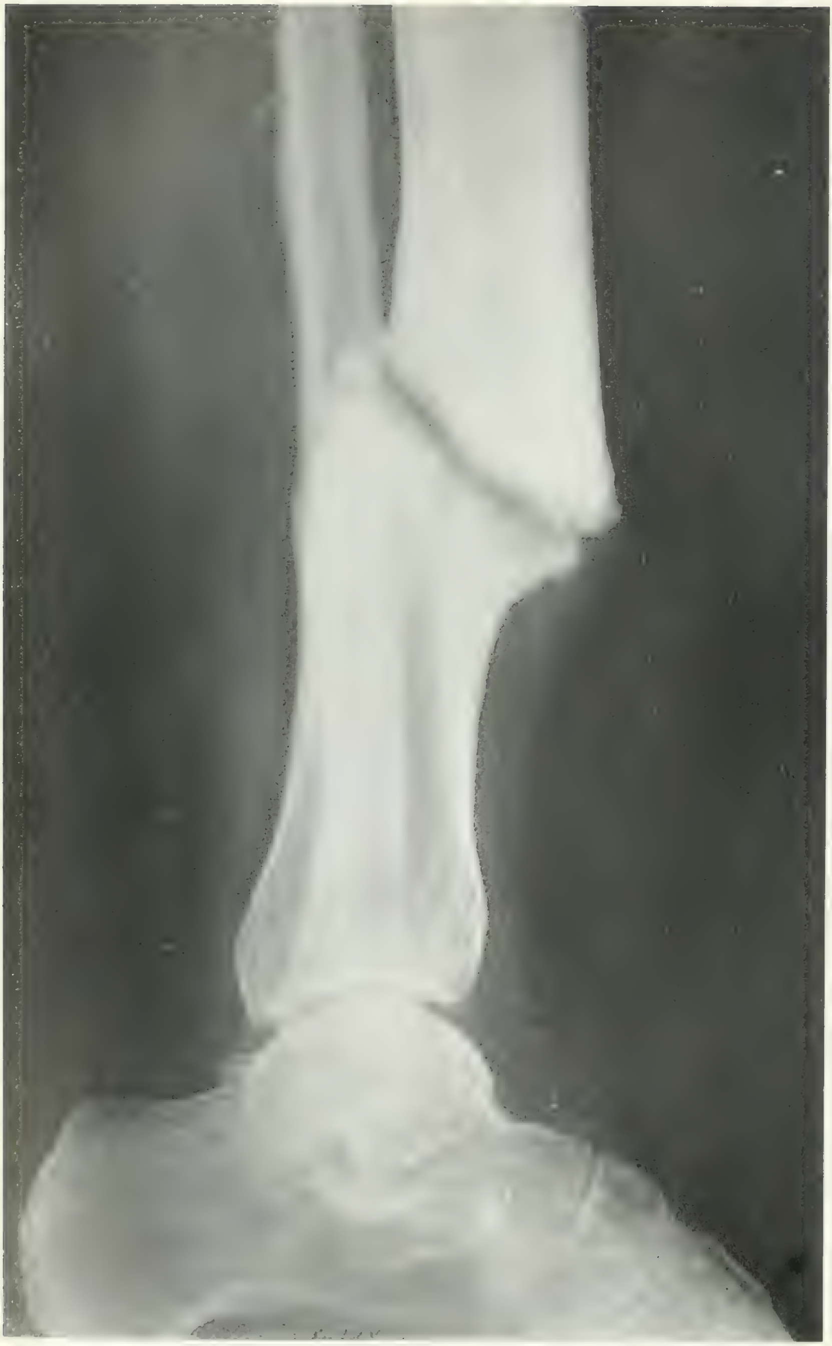
1*a* shows diagram of transplant removed from the long fragment; 2*a* shows transplant removed from the short fragment. 1*b* shows inversion of long transplant to bridge fracture; 2*b* shows short transplant inserted to fill gap left by removal of transplant from long fragment. Catgut sutures in periosteum of graft and shaft.

FIG. 2.



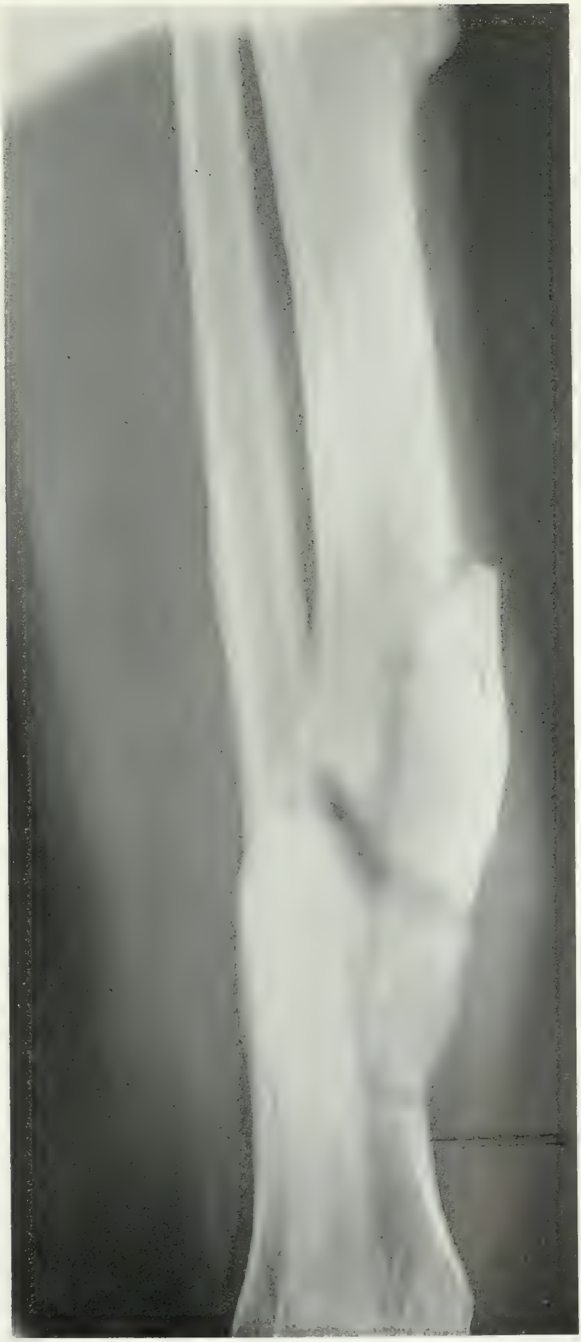
a, type of circular saw used. Note removable metal cap on distal end of shaft. In using the saw, the tip of the shaft which fits into this cap should be greased with sterile vaseline to prevent it becoming too hot to hold. All the metal can be dry sterilized. The flexible shaft is wrapped with a sterile bandage. *b* shows metal cap removed. *c* shows method of holding saw, which gives the operator easy control.

FIG. 3



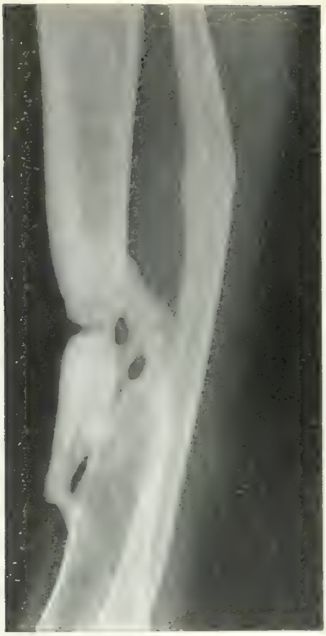
Ununited fracture of lower ⅓ of left tibia, 1½ years after injury.

FIG. 4.



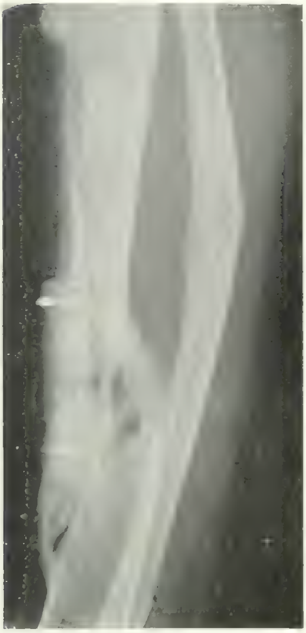
Shows transplant used to bridge fracture in one of our early cases. The transplant was removed from the crest of the tibia and not from the internal flat surface.

Fig. 5.



Non-union after 1½ years.

Fig. 6.



Shows transplant used to bridge the fracture. Silver wire was used contrary to our late technic; also, the transplant was removed from the crest and not from the flat internal surface.

plant is then inverted so that sound bone will bridge the line of the fracture. The part which was the upper end fits into the angle distal to the fracture in the smaller fragment. The piece removed from the smaller fragment is then used to fill the remaining gap in the longer fragment. Both pieces are sewed in by stitching the periosteum of the transplant to the periosteum of the shaft. The skin is then closed with silk-worm and horse-hair and the dressing applied. A plaster-of-Paris cast is applied to include the knee and ankle. This is removed at the end of two weeks. Sutures are removed and a new cast put on which is left for from 4 to 6 weeks. Further treatment is guided by the individual case. Union is usually firm enough to permit walking in from 3 to 6 months.

Case A71534.—X-ray 16559. Male, aged thirty-one. Mining engineer. Date of examination in Mayo Clinic August 2, 1912. Twenty-six months previous to examination, the man had sustained a compound fracture in the lower third of the tibia and fibula. No infection followed. In spite of good treatment by cast, splint and brace, there was but little union and that was fibrous. In October of 1911, he contracted syphilis, which was treated promptly and effectively. At the time of examination in our clinic, although he had had no treatment for 2 months, his Wassermann was negative. He was walking with the aid of a brace but had been unable to resume work.

Operation.—On August 12, 1912, the fracture was exposed and a transplant was moved down from above to bridge the fracture. Healing by first intention followed and the patient was dismissed. Three months later he wrote that the union was firm and asked permission to bear weight on his leg. This he was advised to do gradually.

Case A78083.—X-ray 18621. Male, aged thirty. Farmer. Date of examination January 3, 1913. Patient presented himself for examination because of delayed union of a compound fracture of the left tibia of 1½ years' standing. Infection followed and he was quite ill for 2 months. At the time of examination in our clinic, there were no signs of infection. He had been treated by splints and casts. The union was entirely fibrous, there being free motion at the site of the fracture, and he was using two crutches (Fig. 3).

Operation.—On January 6, 1913, the fracture was exposed and a piece of bone four inches long transplanted from the middle third of the same tibia to bridge the fracture (Fig. 4). Healing occurred by first intention. On May 15, the patient resumed his full duties on the farm. Probably firm union had existed for 6 weeks prior to that time.

Case A78224.—X-ray 18668. Male, aged twenty-eight. Miner. Examination January 7, 1913. Delayed union of fracture of the middle third of right tibia, 1½ years' duration. There was free motion at site of fracture. Two crutches were used. Amputation had been advised by home physicians.

Operation.—On January 9, 1913, bone was transplanted from the same tibia to bridge the fracture. Instead of using catgut as usual, aluminum bronze wire was used. A scar which was the result of the original accident sloughed after being lifted up at the operation. Under alcohol dressings this surface granulated and healed without infection. The patient did not resume his full duties until September 2, 1913. He wrote that the leg was strong before that time but he was afraid to use it. A medicolegal question in this case may have prolonged the convalescence.

Case A80259.—X-ray 19480. Male, aged thirty-two. Laborer. Weight 200 pounds. Examined in the Mayo Clinic February 19, 1913. One year previous, he had sustained a simple fracture in the upper third of left tibia. There was delayed union, and at the end of 6 months the fracture was wired, but without resulting union. When he came for examination, he was still using two crutches.

Operation.—On February 22, 1913, a transplantation was done on the same tibia to bridge the fracture. Primary healing followed and the patient was dismissed with a leather-sheath brace and crutches. On May 11, 1913, he slipped, throwing all his weight on the fractured leg. There was an injury and he returned for treatment. X-ray disclosed a new fracture which had occurred at the point where the upper end of the transplant had been removed. The old fracture was intact. A plaster-of-Paris cast was applied. The patient resumed his work on November 20, 1913, and reports the leg to be solid and straight.

Case A82916.—X-ray 20710. Male, aged thirty-four. Laborer. This patient was examined April 16, 1913. Nine months previous to the examination, he had sustained a simple fracture in the middle third of the right tibia and fibula. Casts and splints were used. After four months, he was operated on for delayed union by his home physician. Silver wire was used. No union resulted and his physician referred him to the Mayo Clinic for treatment. He was on crutches.

Operation.—On April 19, 1913, the fracture was opened and a portion from the same tibia transplanted to bridge the fracture. Primary healing occurred. On October 27, 1913, the patient resumed his full duties and in a recent letter stated that he had walked 10 miles.

Case A82640.—X-ray 20553. Male, aged eight. Date of examination April 9, 1913. Five and one-half years previously had sustained fracture of the middle third of the right tibia. Malposition and imperfect union resulted. Two years ago he sprained his right ankle and examination by the X-ray disclosed non-union of the tibia. It was wired but no union resulted. In August, 1911, a Lane plate was applied but infection followed, and in November, 1911, the plate was removed. Following the removal of the plate the leg seemed to become perfectly straight and quite solid but at about the eighth month, though the leg was straight, there was motion at the site of the fracture. The union became gradually weaker with more motion and the deformity steadily increased. High shoes had been worn to come up over the fracture for more than a year.

Operation.—On April 9, 1913, bone was transplanted, the transplant being obtained from the same tibia. There was a slough of the skin, the result of the poorly nourished old scar, but no infection occurred and the patient's recovery was uneventful. A recent letter states that he is running and playing without any support and the leg seems perfectly solid.

Case A87500.—X-ray 22915. Male, aged thirty-two. Farmer. Examination July 9, 1913. On May 12, 1913, he sustained a compound fracture of the left tibia and of the middle third of the fibula. No infection followed. No union other than fibrous occurred. The fibula had united.

Operation.—On July 11, 1913, bone was transplanted from the same tibia to bridge the fracture. The healing and convalescence were uneventful. The patient resumed full duties by November 1, 1913, the leg being perfectly firm and solid.

Case A89982.—X-ray 22221. Male, aged forty-eight.

Farmer. Examination June 16, 1913. Two months previous had sustained fracture of the lower third of the left tibia. There was slight anterior displacement of the lower fragment and non-union.

Operation.—On July 17, 1913, a transplantation was done from the same tibia to bridge the fracture which was comminuted. A letter from the patient dated December 11, 1913, states that he is walking with a cane. The convalescence was slow in this case, largely because of trauma at the time of the fracture. There was much swelling of the soft tissues, even two months after the fracture occurred.

Case A97369.—Male, aged twenty-two. Chauffeur. Examined December 17, 1913. On November 25, 1911, he fractured lower third of right tibia and was treated by splints, casts, etc., until May, 1912, when an operation was performed. Bone transplant and silver wire were used. No union resulted.

Operation.—On December 23, 1913, in the Mayo Clinic a piece of bone 4 inches long was removed from the middle third of the tibia and used as a transplant to bridge the fracture. The wound healed by first intention.

THE TREATMENT OF UNUNITED FRACTURES OF THE TIBIA BY BONE TRANSPLANTS.

A REPORT OF FIVE TRANSPLANTATIONS WITH FIRM BONY UNION.

BY ERNEST F. ROBINSON, M.D.,

OF KANSAS CITY, MO.

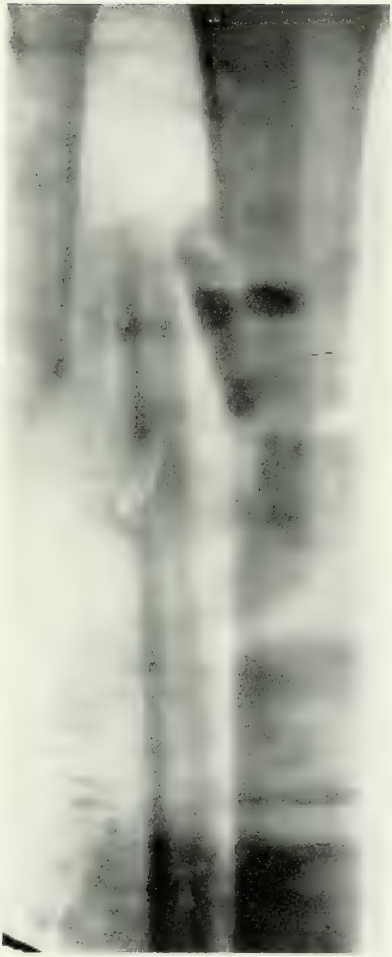
WITHIN the past twelve months five cases of ununited fracture of the tibia have been treated by me by the transplantation of bone with such uniform success and so little mechanical difficulty, that I desire to place them on record as a demonstration of what I believe to be the best and only certain method of securing union in this class of most obstinate and often almost hopeless injuries.

CASE I.—Patient, A. S., a Russian laborer forty years old, entered the General Hospital, November 27, 1912, with comminuted fracture of both bones of the left leg. The X-ray demonstrated displacement of a large fragment of bone of the tibial fracture with shortening of both bones. Fracture of both bones was in upper third. The limb was immobilized temporarily in blanket splint for three days and then in light plaster case. Limb was left immobilized for six weeks with occasional massage and passive movement. At the end of this time the deformity due to misplacement was easily palpable and limb was movable at point of fracture. The second X-ray at this time exhibited very little callus formation and no bony union. Open operation, January 14, 1913. Ends of tibial fracture were exposed and sawed so that they could be placed in apposition with no deformity. A piece of bone five and one-half inches long was removed from opposite tibia and introduced into medulla of ends of fractured tibia and approximated. Wound repaired and limb placed in plaster case immediately. For a week after the operation patient's temperature varied from 100° to 100.4°, pulse averaging 100. The sound limb was redressed at end of six days. Slight infection of surface wound was found. After this redressing, temperature and pulse have been normal. Silkworm-gut sutures. No evidence of infection on grafted side. At the end of four weeks patient was up and about on crutches. Recovery so far uneventful. February 10, 1913, walks about ward on his cast without pain. Bony union.

CASE II.—Patient, L. J., a German laborer, forty-seven years old, suffered a comminuted fracture of the left tibia and fibula, and a comminuted fracture of the left radius, as a result of a railway accident December 10, 1912. At the time of his admission to the Swedish Hospital it was noted that his body was covered with syphilitic rupia. This disappeared under mercury and large doses of potassium iodide in two weeks. An anæsthetic was given and his fractures reduced. A splint was applied to the forearm and a well-fitting plaster case to the leg. The arm united nicely. The leg, however, failed to show any evidence of bony union after eight weeks, and an operation was decided upon. This was performed January 28, 1913, at the City Hospital, under ether anæsthesia. A longitudinal incision seven inches long was made, just to the inner side of the crest of the tibia. The ends of the bone, while in good apposition, were not united but were covered with granulation tissue. A loose fragment, about one inch long, was detached from the posterior portion of the upper fragment. Owing to the great irregularity of the broken bone, the ends were cut off with a chain saw and the granulation tissue in the medullary cavity was reamed out for a distance of about two inches. The crest of the opposite tibia was now laid bare and a piece of bone about five inches long was removed. This was detached with the chisel after the crest had been cut to the required depth at either end with the saw. No attempt was made to remove the periosteum from the transplant. This was now immediately driven into the reamed out end of the lower fragment. Traction was made upon the leg and this large bone peg was inserted into the upper fragment and the bones brought into accurate apposition. A small nail was driven into the upper end in order to keep the transplant in place. The muscles and fascia were brought together with a few catgut sutures and the wound closed without drainage. The leg was put up in a plaster case. Primary union resulted. Six weeks later firm bony union had resulted.

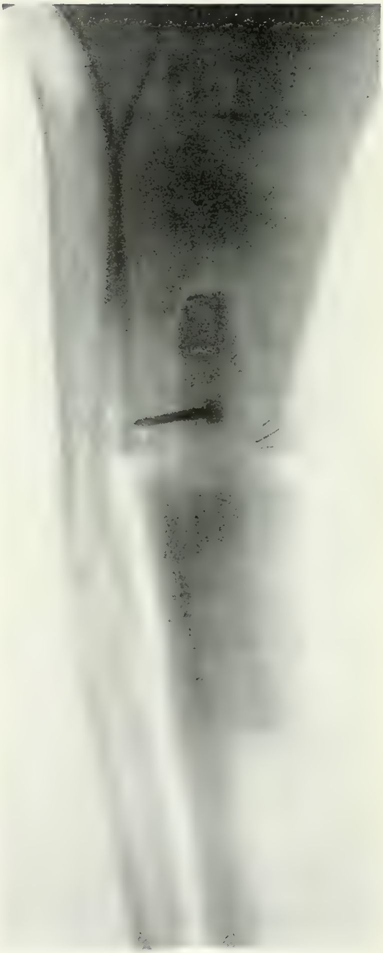
CASE III.—H. E. C., General Hospital, carpenter, broke his tibia and fibula, about middle, by a fall from a scaffold. No union

FIG. 1.



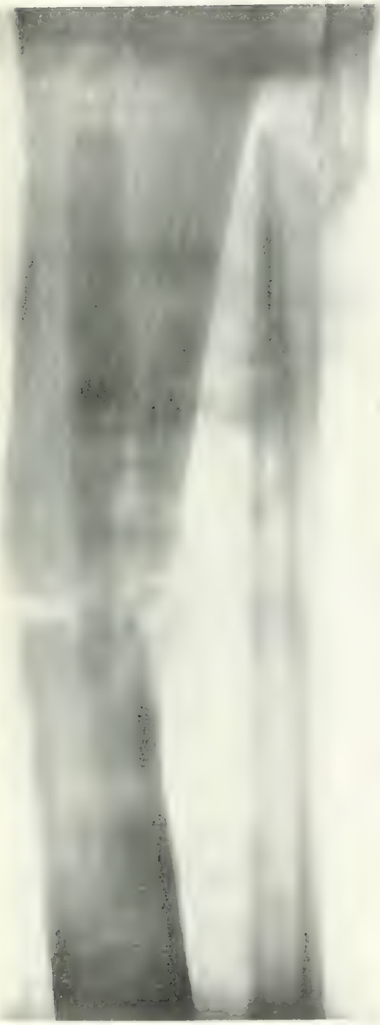
Bone transplant for ununited fracture of tibia.
(Case I.)

FIG. 2.



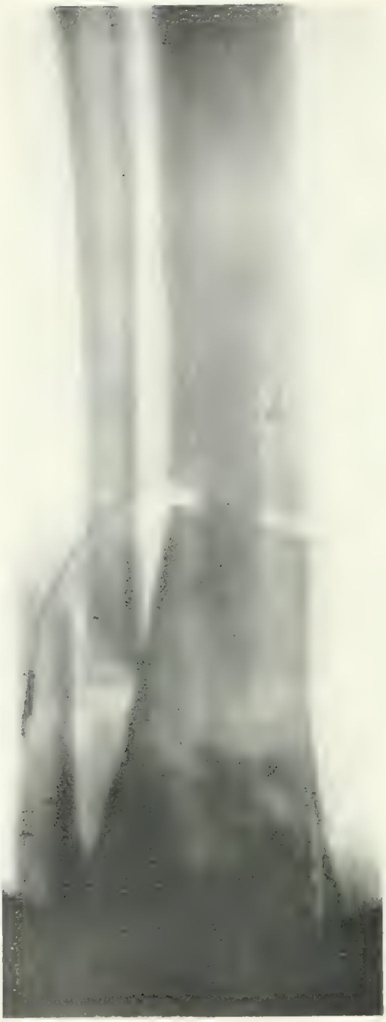
Bone transplant for ununited fracture of tibia.
(Case II.)

FIG. [illegible].



Bone transplant for ununited fracture of tibia.
(Case III.)

FIG. 4.



Bone transplant for ununited fracture of tibia.
(Case IV.)

after nine weeks. Operation December 30, 1913. Incision four and one-half inches, slightly curved just to outer side of tibial crest. Several small fragments of bone removed from between the ends of the broken shaft. A transplant about four inches long by one-half by one-half inch was cut from the crest of the opposite tibia with a chisel and saw. This was inserted into the reamed out ends of the upper and lower fragments and the bones brought accurately together. A plaster case was applied. After ten days this was replaced by another, correcting the slight deformity shown in the X-ray picture. Firm bony union resulted.

Case IV.—C. W., a mulatto thirty-five years old, laborer, suffered a comminuted fracture of the right tibia as a result of a fall in July, 1913. Dr. Carbaugh reduced the fracture and retained it in good position by splints and later a plaster case. Ten weeks after the accident, however, only fibrous union had taken place. September 21, 1913, he was taken to the hospital. Under ether anæsthesia an incision five inches long was made just to the outer side of the crest of the tibia. Fibrous tissue and muscle fibre was found between the ends of the broken bones. The ends of the fragments were cut off with a chain saw, both bones were reamed out for a distance of two and one-half inches with a Murphy reamer. A bone transplant about four and one-half inches long and one-half inch wide and thick was removed from the crest of the opposite tibia. This was easily and quickly accomplished by a Hey's saw and chisels. It was doubly clamped to avoid the danger of dropping it. The transplant was then driven into the reamed out end of the upper fragment and aided by extension pushed into the lower fragment. This held the bones most accurately in apposition. Primary union resulted with firm bony union at end of seven weeks.

Case V.—A. H. S., thirty-three years old, bridge carpenter, suffered a fracture of tibia and fibula as a result of a fall in January, 1913. After seven weeks there was no evidence of bony union. A removable case was applied and he was advised to walk upon the injured leg. After two weeks of this treatment there was still no evidence of union. Operation April 28, 1913, a five and one-half inch incision was made over the tibial crest and the ends of the broken shaft cut off by Gigli wire saw and rongeur forceps. A transplant about five inches long by one-half by two-fifths of an inch was removed from the crest of the opposite tibia. This was inserted into the reamed out end of upper fragment for about two and one-half inches. A groove was cut in the lower fragment to admit the transplant, which was pushed down into the reamed out cavity in the lower fragment. The wound was closed without drainage. Primary union resulted. Bony union was somewhat delayed, owing, probably, to the fact that the patient left the hospital and wore the same case for several weeks. Twelve weeks after operation, however, we had an opportunity of examining the leg. Patient was then walking about with a loose case still, which gave him no support. Upon its removal it was found that good bony union had taken place. Union in this case would have undoubtedly been more prompt had the patient not taken upon himself the responsibility of the after treatment.

My own experience would lead me to believe that non-union of the tibia and fibula is by no means uncommon. This seems particularly true when the fracture occurs at about the middle or upper third. I am inclined to think that a thrombus, developing in the nutrient artery of the tibia (which enters the bone at this point), is probably the explanation. In consequence of this impaired nutrition the process of bone repair is so delayed that connective tissue is interposed and forms a permanent block to the bridging across the gap by the Haversian system of osteoblasts. Murphy's contention seems most logical that the autogenous bone graft or transplant acts as an osteoconductive superstructure which carries the bone forming process across. If this is true a properly placed transplant, well in contact with either fragment, cannot fail, if it extends well beyond the infiltrated area, to bring about bony union in all cases of ununited fracture.

In my transplants I did not remove the periosteum. In two of the cases, however, in forcing the transplant into the reamed out ends of the tibial shaft the periosteum was completely striped off from the lower half of the graft. Nevertheless union occurred just as promptly as when it remained perfectly intact. This would bear out Macewen's statement that the periosteum is not essential in the bone-forming process.

It will be noted in these cases that no effort was made to secure union of the fibula. Perfect anatomical union of this bone is not essential, as the weight is all borne by the larger bone. In cutting the transplant a special dental engine or circular electric saw is of course most convenient. It is not, however, essential to accurate or rapid work. At the ordinary well-equipped hardware store one can secure a small triangular cabinet-maker's or wood-carver's chisel, which very materially aids in cutting the long transplant without danger of splitting or splintering. It materially helps, also, in loosening the graft after it has been outlined with the grooved chisel, if the splitting force of the larger chisel is applied from beneath the crest of the tibia upward. The bone then breaks in the grooved lines. Transplants six to ten inches long can be cut in this way with safety.

No drainage was used in any of my cases. The application of a tourniquet materially aided me in working rapidly. In none of my cases was the gloved hand, or any gauze, or any instrument that had come in contact with the skin, allowed to touch the wound, thus greatly lessening the danger of sepsis.

The ultimate result in these cases has been firm, bony union with but little callus formation. In the two earliest cases this has been so absorbed that almost no deformity whatever can now be detected.

TRANSVESICAL PROSTATECTOMY IN TWO STAGES.

BY PAUL MONROE PILCHER, M.D.,

OF BROOKLYN, NEW YORK.

I. THE PATHOLOGY OF CHRONIC PROSTATIC OBSTRUCTION. II. CONDITION INFLUENCING THE CHOICE OF TREATMENT-METHODS. III. THE THREE PHASES OF INTERRELATION BETWEEN OBSTRUCTION AT THE VESICAL OUTLET AND RENAL FUNCTION. IV. THE INDICATIONS FOR AND THE TECHNIC OF SUPRAPUBIC CYSTOSTOMY. V. TECHNIC OF TRANSVESICAL PROSTATECTOMY.

INTRODUCTION.

SINCE we have adopted the transvesical operation for the relief of urinary obstruction due to changes in the prostate, we have been able more fully to study the so-called living pathology of the condition inasmuch as the vesical outlet can be studied with the prostate *in situ,* the nature of the obstructing mass determined and the resultant deformities of the bladder studied. The removal of prostates in one piece in many cases and the interurethral enucleation in others has provided us with new material for extending our observations concerning the gross pathology of the disease.

Studying this last series of cases we are led to disagree with some of the more recently advanced theories concerning the pathology of the disease. In presenting this subject, therefore, we first offer our observations on the points in question. We do not reiterate much of the work which has already been published by Dr. Lewis S. Pilcher and myself.[1]

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[1] Pilcher, Lewis S.: Choice of Operative Method for Removal of the Hypertrophied Prostate. ANNALS OF SURGERY, 1905, xli, 565.

Observations Upon the Removal of the Prostate for the Cure of Prostatic Dysuria. *New York State Journal of Medicine,* June, 1906.

Urinary Obstruction from Prostatic Hypertrophy. *Year Book of the Pilcher Hospital,* 1911, i, p. 60.

Pilcher, Paul M.: Pathology and Etiology of Obstructive Hypertrophy and Atrophy of the Prostate Gland. ANNALS OF SURGERY, 1905, xli, 481.

Choice of Operation for the Relief of Prostatic Dysuria and the Pre-

I. THE GROSS PATHOLOGY OF PROSTATIC HYPERTROPHY.

Most of the recent articles dealing with prostatic hypertrophy have presented evidence and theories concerning the gross pathology of the prostate. The work of Tandler and Zuckerkandl (1) tended to show that all of our previous ideas of the gross pathology of prostatic hypertrophy were wrong. Lowsley (2) presented his study of a series of sections of the human prostate in its early developmental period, which were distinctly in contrast to the series presented by the Austrian scientists. Wilson and McGrath (3) presented their studies of over 400 specimens and agreed to a certain extent with the theories of Tandler and Zuckerkandl. Henry Wade (4) gives the results of his exhaustive study of prostatism and deals with the surgical anatomy and pathology of the operative treatment.

Our own observations have not satisfied us that these theories are absolutely demonstrated to the satisfaction of surgical pathologists. Lowsley agrees with the more advanced pathologists and recognizes five lobes in the prostatic mass. The middle lobe is quite independent of the others and its tubules are distinctly separated from the others. They are situated within the gland structure and are in relation with the floor of the urethra. The posterior lobe is situated furthest from the bladder and is almost an independent structure. It is further of interest to note that the tubules of the middle lobe lie side by side with those of the lateral lobes, but at no point do they intermingle. The lateral lobes are made up of a series of tubules on each side of the urethra and the acini of these lobes form the main mass of the gland. It is distinctly indicated that the lateral lobes are in direct relation with the urethra. The posterior lobe seems to be almost an independent structure and is seldom involved in hypertrophy of the gland. It, how-

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liminary Treatment Indicated. *Journal of the Michigan State Medical Society,* January, 1912.

The Suprapubic Two-step Operation for the Removal of the Hypertrophied Prostate. *American Journal of Surgery,* June, 1912.

The Operative Relief of Obstructive Hypertrophy of the Prostate. *Journal of the Michigan State Medical Society,* September, 1913.

ever, seems to be a starting point for malignant degeneration in many cases. The subvesical accessory glands of Albarran, which develop on the surface of the median lobe, are not of much clinical importance in the experience of the writer.

As a result of our personal observations hereinafter detailed we believe:

1. That Tandler and Zuckerkandl are mistaken in their conclusions that prostatic hypertrophy is always a hypertrophy of the anatomical middle lobe.

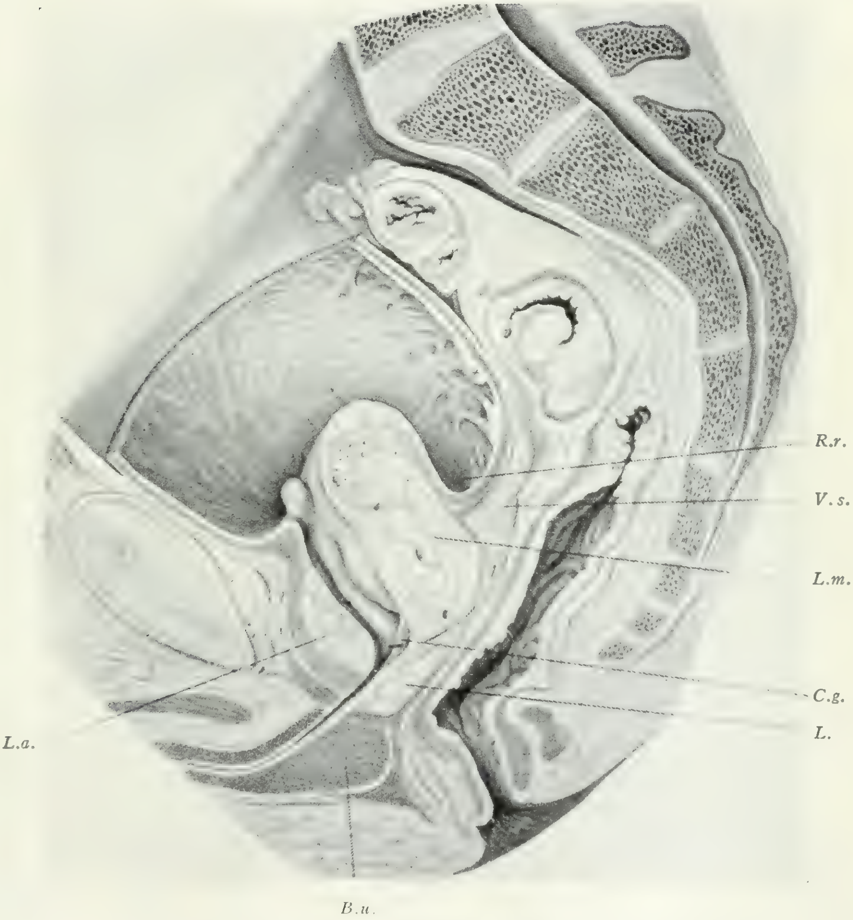
2. That Tandler and Zuckerkandl are incorrect in assuming that the so-called prostatectomy does not in a great majority of cases mean practically total removal of the prostate. We appreciate that in some cases of irregularly developed prostatic adenomata some prostatic tissue becomes atrophied and compressed and forms a shell around the adenomatous mass and is not entirely removed at operation.

3. We question that the surgical capsule is formed only by compressed peripheral parts of the prostate.

4. We agree that the anatomical relations of the hypertrophied prostate to the sphincter vesicæ, the bladder itself and the ductus deferentes recommend the transvesical route as the one to be chosen in removing an enlarged prostate.

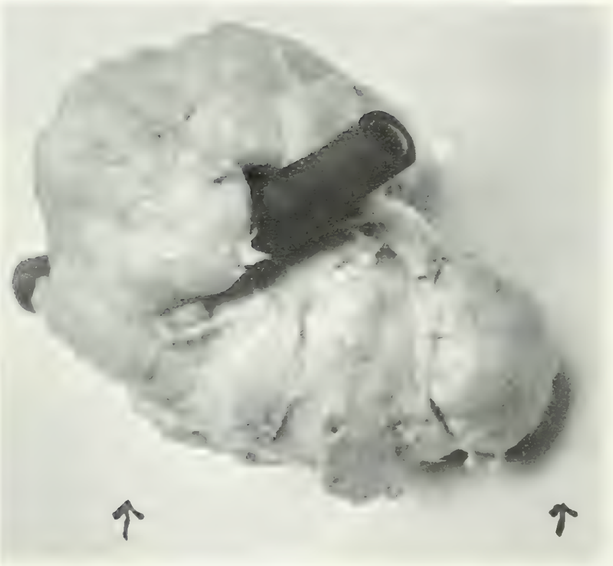
The first three of the conclusions advanced by the Austrians are so at variance with the accepted ideas of the pathology of the prostate in cases of obstructive hypertrophy, that the writer took occasion to visit Vienna and study the specimens which had been prepared by Professor Tandler and from which these conclusions were drawn. The writer spent some time in going over the question with Professor Tandler so that these observations are not based upon hearsay. Studying Tandler's specimens we accept his theory that the posterior lobe seldom hypertrophies. In other words, the enlargement takes place toward the bladder. However, in my mind the exhibits do not prove that the enlargement always involves the median lobe alone. If enlargement of the median lobe takes place, it must proceed along the avenue of least resistance, which is through the vesical outlet, gradually dilating it and forcing the sphincter

FIG. I.



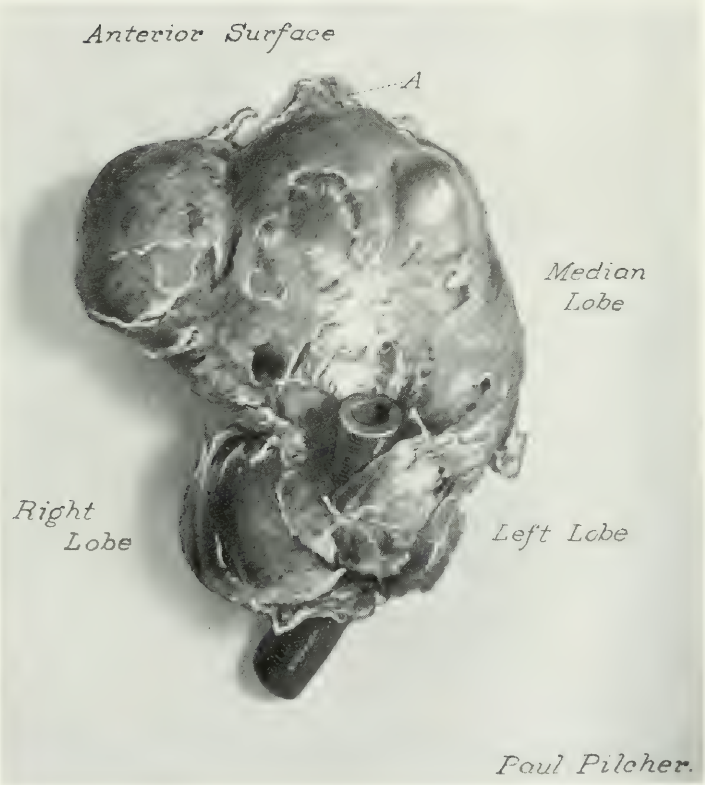
Sagittal section through the pelvis, showing the prostate hypertrophied. *B.u.*, bulbus urethralis; *C.g.*, caput gallinaginis; *L.a.*, lobus anterior; *L.m.*, lobus medius; *R.r.*, recessus retrouretericus; *V.s.*, vesicula seminalis. A short probe projects from the ejaculatory duct. (Tandler and Zuckerkandl, verlag von Dr. Werner Klinkhardt, Leipzig. Wilson and McGrath.)

Fig. [illegible]



Prostatic mass removed by transvesical operation, rubber tube showing direction of urethra. Beneath the rubber tube is a greatly hypertrophied middle lobe. The lateral lobes are seen forming the sides and roof of the urethra, but are not in any way obstructive.

Fig. 3.

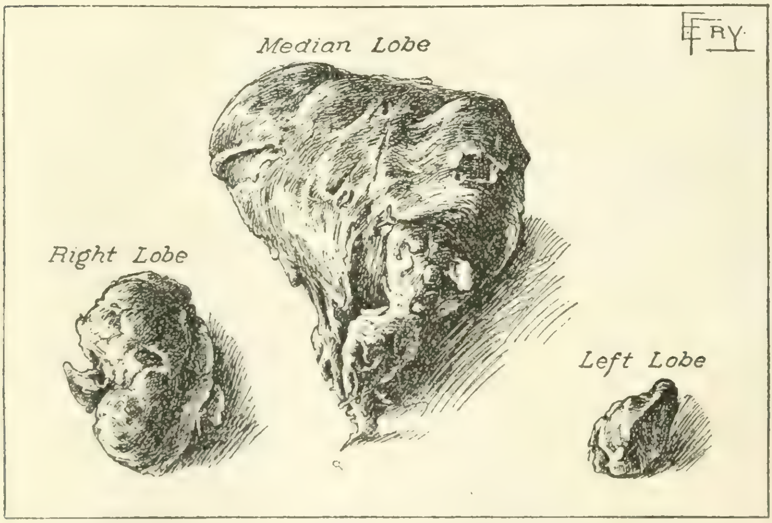


Enormous median lobe enlargement of the prostate with adenomatous changes in the lateral lobes. These lobes are smaller than normal and show no atrophy due to pressure. The specimen presents a view of the anterior face. The part above the rubber tube was entirely intravesical. The anterior face is covered by mucous membrane.

ring wide open. That this frequently occurs is well shown by many specimens. However, it is hard to accept the theory that in some cases, or in many cases, the enlargement of the median lobe takes place in the direction of the lateral lobes, displacing them and causing atrophy of these lobes, compressing them out into a shell-like capsule; to produce a lateral extension of an adenoma of the median lobe, the expansion must take place, not along the avenue of least resistance, but against a firm, well-developed structure. Judging from the anatomical relations as found on the operating table, Tandler's conclusions as to the part of the prostate involved in the obstruction are incorrect.

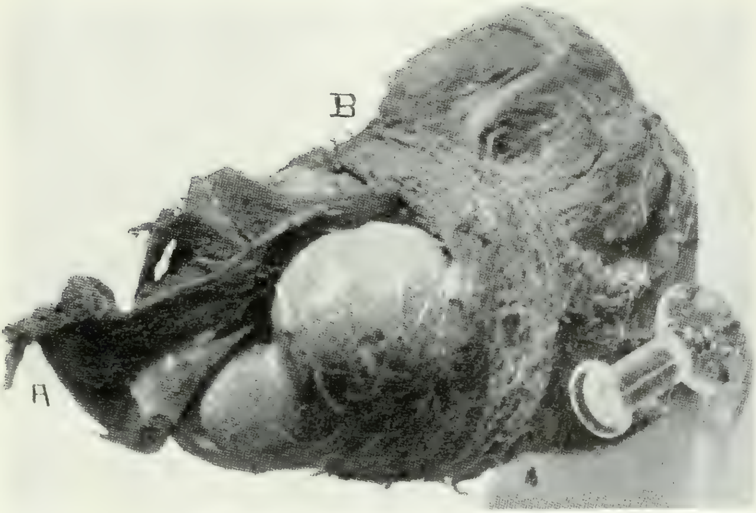
Fig. 1 is an illustration taken from the work of Tandler and Zuckerkandl, showing a sagittal section through the pelvis in a case of prostatic hypertrophy. We agree that this represents a typical case of median lobe enlargement. A number of other illustrations which are shown in the work of Tandler and Zuckerkandl are unquestionably examples of median lobe enlargement, for in each the adenomatous mass is more or less symmetrical in the median line and is forced through the sphincter dilating it. The same phenomenon has been plainly shown in many of our own specimens, for example, Figs. 2, 3, and 4. At the same time, the enlargement of the lateral lobes without the median lobe enlargement may take place, and in such cases the sphincter is greatly dilated and surrounds the hypertrophied mass. Such a case is seen in Fig. 5. In this case the lateral lobes have become enormously hypertrophied and have carried the median lobe, which is also enlarged, through the sphincter well into the bladder. It cannot be conceived that, after the enucleation which was accomplished in this case, any prostatic tissue was left behind unless it was the posterior lobe which is so nearly independent. Fig. 6, however, shows a different condition. This was a case of complete urinary obstruction, which had lasted for three years. *B′*, *B′* are the adenomatous lateral lobes. *B* is a greatly hypertrophied median lobe. *A* is a crescent-shaped calculus, and the remaining pieces of tissue are compressed and atrophied bits of prostatic tissue which still remained imbedded in the capsule of the prostate after the adenoma had been enucleated. Fig. 7 is an example of symmetrical enlargement of the median and both lateral lobes. Fig. 8 is an example of bilateral hypertrophy without any median lobe enlargement. The specimen is very distinct and convincing on this point. Fig. 9 is another example of irregular hypertrophy of the lateral lobe with very little median lobe enlargement. Fig. 10 shows a specimen removed in one piece in which the median lobe is enlarged and has pushed forward into the bladder and distorts the urethra, lifting it up and making it almost impossible to empty the bladder. The position of the sphincter is indicated by the arrows. Fig. 11 shows still another type of development. The lateral lobes in this case had been previously removed by perineal operation. The symptoms persisted and three years later this median lobe enlargement, with a very freely movable ball valve attachment, was taken out by a transvesical operation. No remnants of the lateral lobes could be found. It is interesting to note the position of the internal sphincter as indicated by the arrows.

FIG. 4.



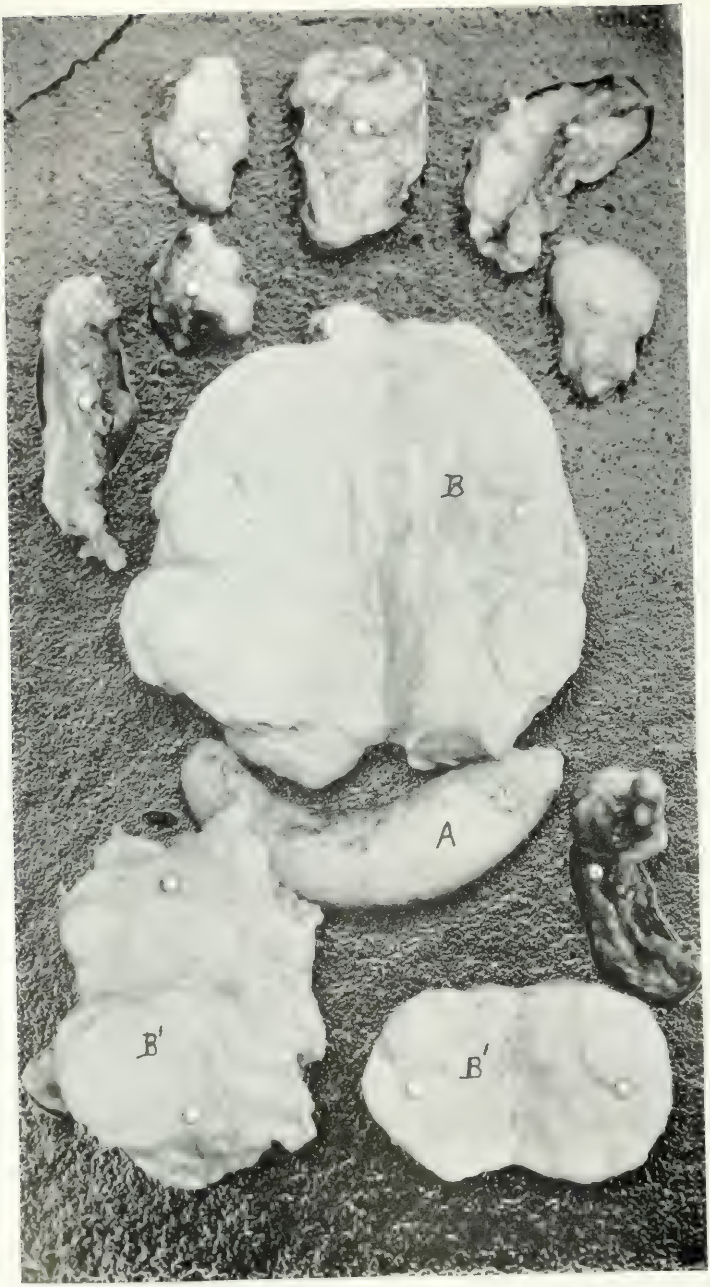
Drawing showing the three lobes of the prostate separated. Same specimen as Fig. 3.

FIG. 5.



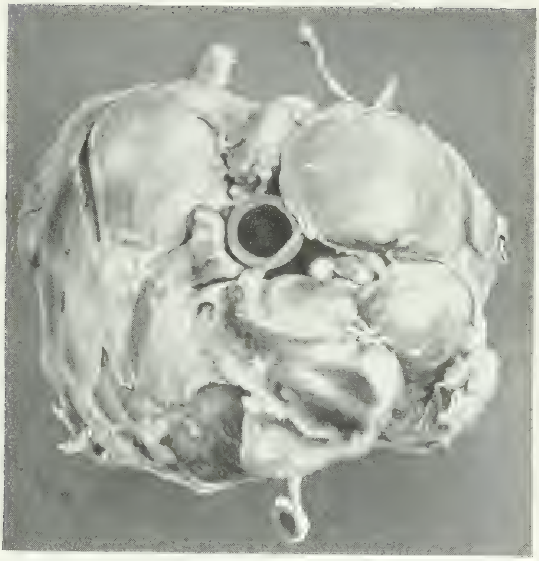
Photograph of hypertrophied prostate removed by suprapubic route. Showing bilateral and median enlargement. At vesical pole, *A*, the capsule and mucous membrane of the bladder are shown stripped back from the glandular portion of the gland. At *B* is seen the circular capsule which passes entirely around the gland.

FIG. 6.



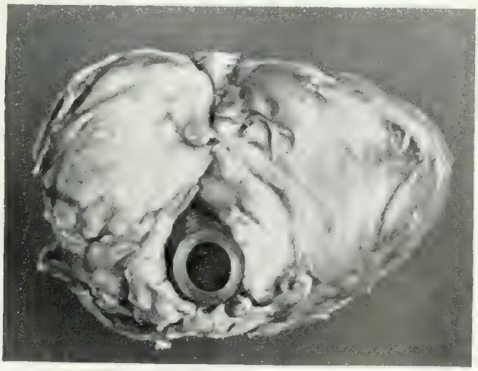
Photograph of prostatic masses removed by transvesical route. A, is a crescent-shaped nodule; B, a large median lobe; B′ B′, the two lateral lobes. The other pieces of tissue shown in the specimen are atrophied prostatic tissue adherent to the capsule.

Fig. 7.



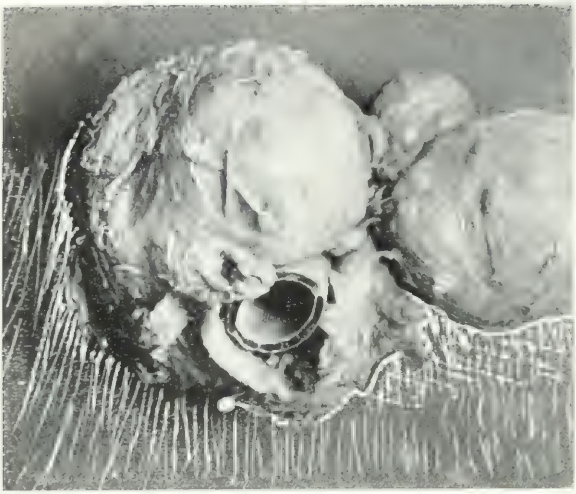
Specimen removed by transvesical operation showing symmetrical enlargement of both median and lateral lobes.

Fig. 8.



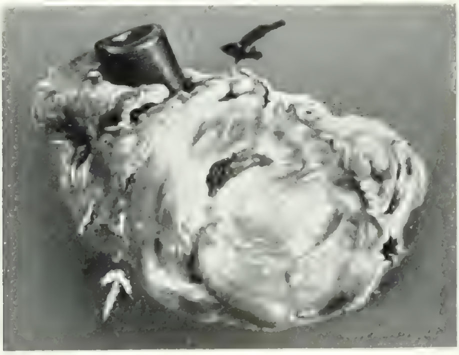
Specimen removed by transvesical operation showing hypertrophy of lateral lobes without involvement of median lobe.

Fig. 9.



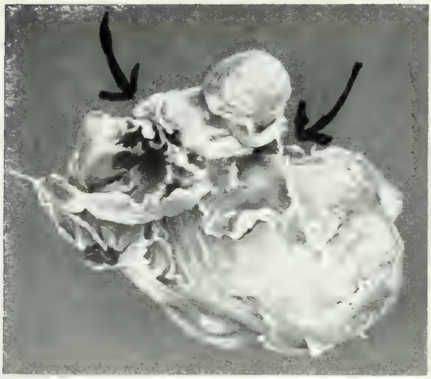
Specimen removed by transvesical operation showing irregular hypertrophy of the lateral lobes with very little median lobe enlargement.

Fig. 10.



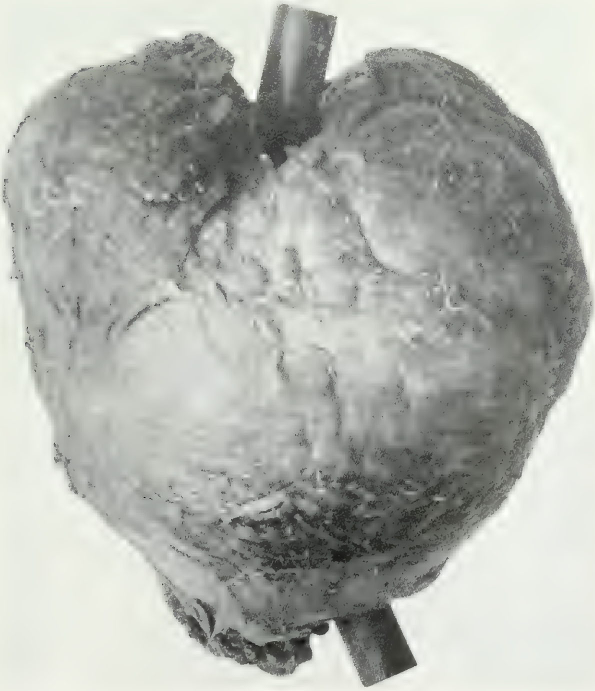
Specimen removed by transvesical operation showing marked median lobe enlargement with practically no lateral lobe enlargement.

FIG. 11.



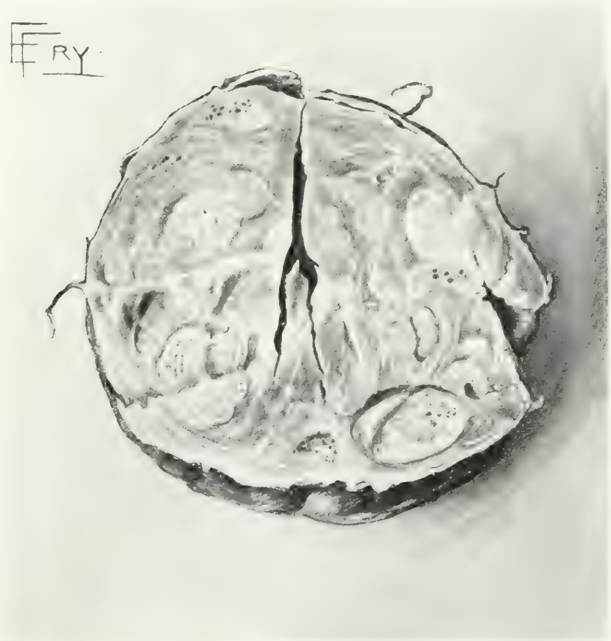
Median lobe enlargement with ball valve attachment.

FIG. 12.



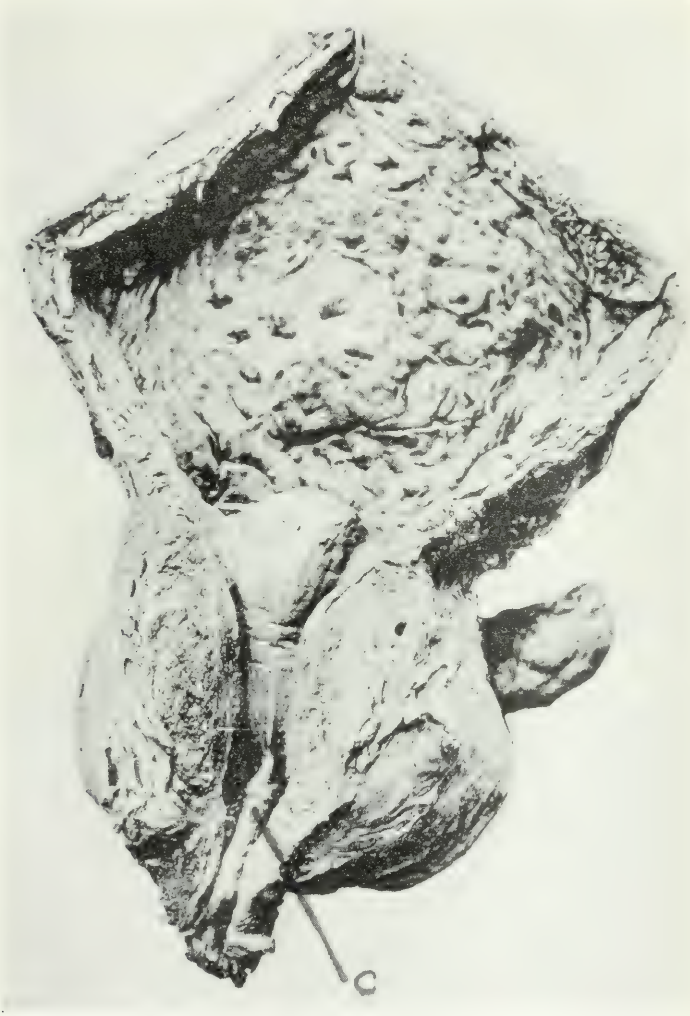
Enlargement of the prostate in which the two lateral lobes are involved. The vesical surface of the prostate appears at the top of the picture. This specimen was removed within its capsule and is a perfect example of coincident hypertrophy of both lateral lobes without any marked median lobe enlargement. The section through this mass is seen in the following figure which shows the narrow cleft occupied by the urethra. The two lateral masses and the small adenomatous median lobe are seen.

Fig. 13.



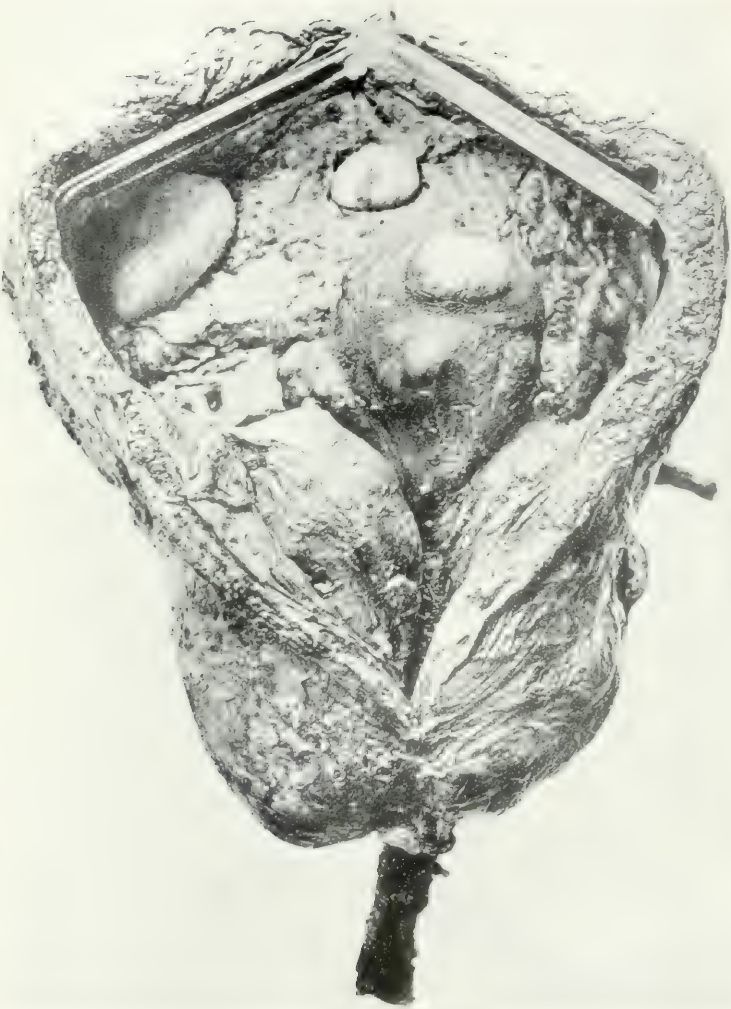
Cross section of specimen shown in Fig. 12 showing relation of median lobe and two lateral lobes to the urethra.

Fig. 14.



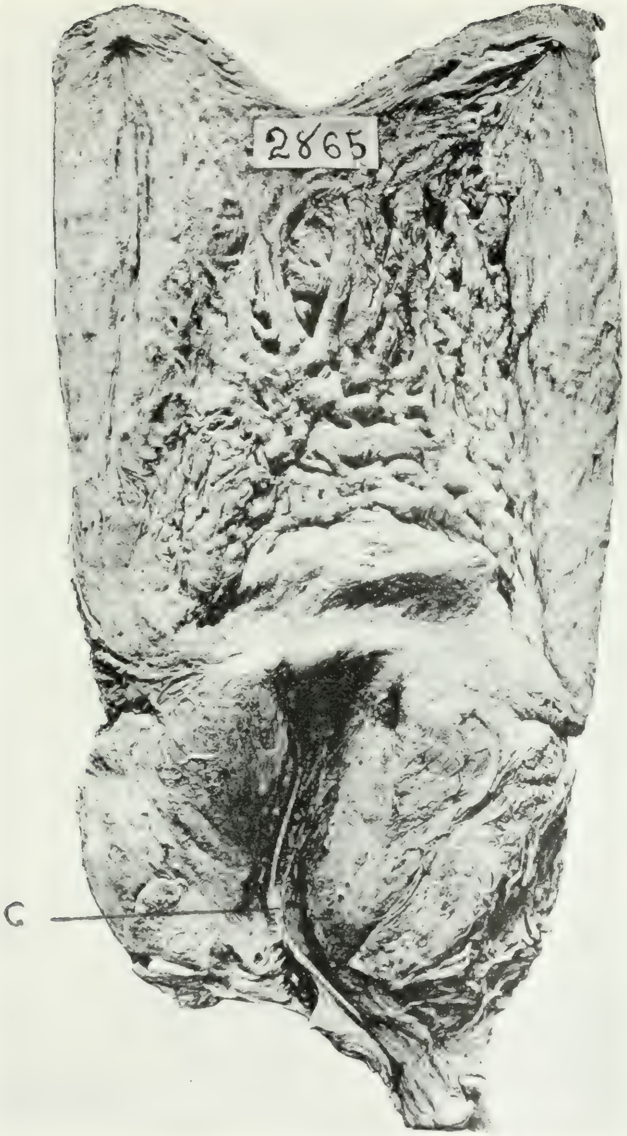
Bilateral and median lobe hypertrophy of prostate. Position of colliculus. This photograph shows the exact relation of the urethra, hypertrophied prostate and bladder as an example of moderate bilateral hypertrophy of the prostate, with median lobe enlarged and projecting into the bladder, the median lobe forming the chief obstruction. Following the urethra upward from the bladder, it will be seen that the urethra inclines sharply downward due to the bulging of the median lobe, which forms the floor of the urethra as far forward as the colliculus. If the finger were introduced into the urethra through the bladder, it can be easily seen from this picture how the entire prostate could be removed without injury to the colliculus. (Reproduced from Francis S. Watson's work on The Operative Treatment of the Hypertrophied Prostate.)

FIG. 15.



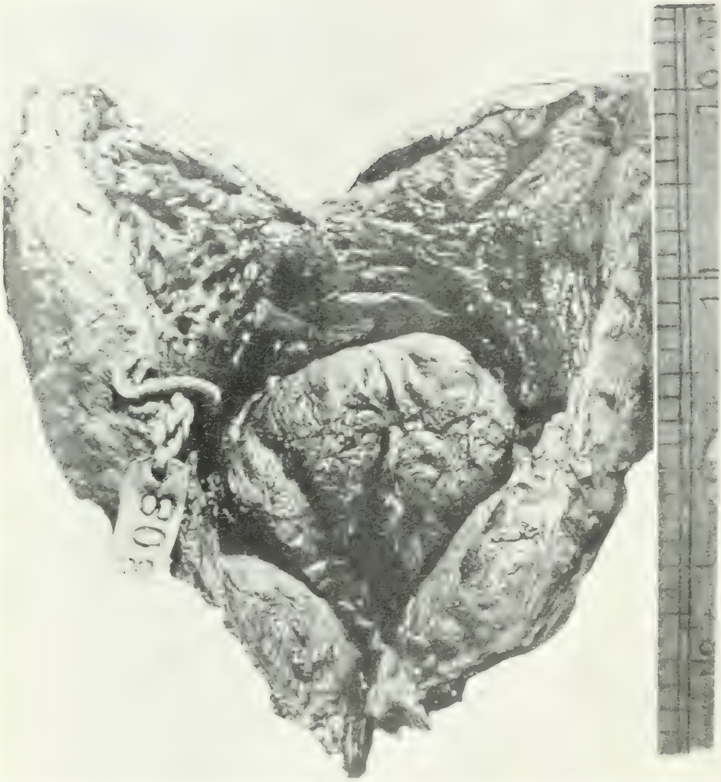
Photograph of bladder and prostate which speaks for itself. It is impossible to conceive how anyone would deny that this photograph represents a case of hypertrophy of both lateral lobes of the prostate and the median lobe. The photograph showing the distinct relation between the bladder wall and the specimen bears witness to the incorrectness of the conclusions of Tandler and Zuckerkandl when they say that such hypertrophy does not exist. (Reproduced from Francis S. Watson's work on The Operative Treatment of the Hypertrophied Prostate.)

FIG. 16.



Photograph of another specimen of obstructive hypertrophy of the prostate demonstrating another phase of hypertrophy of the lateral lobes. Position of the colliculus. In this case the two lateral lobes have developed unequally, that on the right side of the specimen being much the larger and distorting the urethra very greatly. Both lateral lobes are hypertrophied and the median lobe is represented by a thickened area which becomes a bar because of its being raised up and forced bladderward by the enlarged lateral lobes. If these hypertrophied masses originated from the median lobe, the floor of the urethra would be raised up, whereas the specimen shows the floor of the urethra only distorted in a lateral direction, while the floor is actually depressed. The position of the colliculus in this case is also well seen. (Reproduced from Francis S. Watson's work on The Operative Treatment of the Hypertrophied Prostate.)

FIG. 17



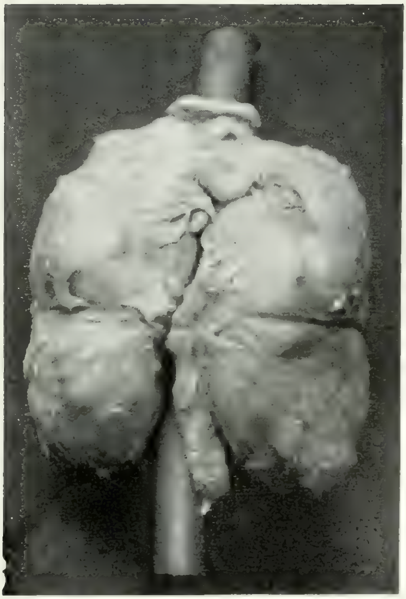
Photograph of a perfect example of a median lobe enlargement without hypertrophy of the lateral lobes. (Reproduced from Francis S. Watson's work on The Operative Treatment of the Hypertrophied Prostate.)

In this case we had the obstruction of the enlarged mass and in addition a ball valve action.

Fig. 12 is the photograph of a specimen, actual size, removed in one piece. It is a perfect example of hypertrophy of both lateral lobes of the prostate. Fig. 13 shows a section through the centre of this mass and shows quite distinctly the three lobes, the two lateral lobes and the median lobe, and their position in relation to the urethra. The median lobe extends up like a wedge between the two lateral lobes and is only moderately enlarged. In this connection reference may be made to the series of photographs of specimens which were published in 1888 by Francis S. Watson, of Boston, in his treatise on the Operative Treatment of Hypertrophy of the Prostate. Plate 4 (reproduced here as Fig. 14) shows a very important feature; the lateral lobes are moderately enlarged, the median lobe is distinctly enlarged and is projecting into the bladder, forming the cause of the obstruction. Distal to the median lobe enlargement is seen a raised-up portion, which is the colliculus or verumontanum, at which point the vasa deferentia empty into the urethra. If the finger is introduced into the urethra by the transvesical route in enucleating the prostate, one can easily see from the specimen how the colliculus may be preserved. Fig. 15 is an undeniable example of hypertrophy of both the lateral and median lobes of the prostate. This specimen, which is a dissection not only of the prostate but of the bladder as well, shows exactly the relation which no drawing could so well express. Fig. 16 shows another phase which is a bilateral hypertrophy of the prostate with a slight median lobe development causing a distinct prostatic bar. The tortuous course of the urethra, the presence of the colliculus and its relative position are clearly shown. No one could argue that in these specimens such a hypertrophy originates from the median lobe alone. The floor of the urethra is very clearly shown and is seen to be free from all hypertrophied tissue. This portion of the urethra must invariably be involved, at least that portion between the colliculus and the sphincter, in all median lobe enlargements. Fig. 17 is a perfect example of median lobe enlargement alone.

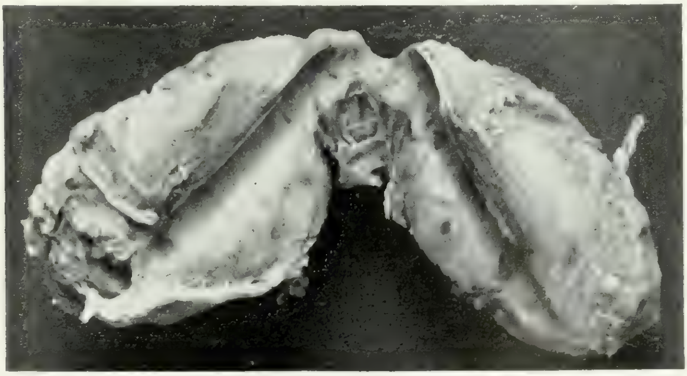
In this case the lateral lobes are distinct, but not hypertrophied. The specimen shown in Fig. 18 shows well the part taken by the lateral lobes in some cases of obstructive prostatic overgrowth. The specimen was removed by the transvesical route, and the entire deformed portion of the prostate was removed in one piece. Fig. 18 shows the under surface of this prostatic mass. A rubber tube passing through the specimen indicates the position of the urethra. At the top of the specimen is seen a small collar which is the mucous membrane stripped up from the internal sphincter. This sphincter could be appreciated by a finger in the bladder. Fig. 19 is another photograph of this same specimen viewed from the anterior surface, showing, roughly, the course of the urethra, as exaggerated by the furrows produced by the presence of the rubber tube in the hardened specimen. The two lateral lobes which appear like the wings of a butterfly are joined together across the median line by a practically normal median lobe which is in no way hypertrophied. The collar of mucous membrane also appears at the top of this specimen and shows the lack of any bulging in the bladder. As far as could be appreciated by the finger, the entire prostate was removed in this case with the possible exception of the posterior lobe of the gland which was distal to the ducts, but the remains of which could not be appreciated by the finger. Examination of the cavity from which this prostate was removed, made immediately after the operation, demonstrated no tissue remaining which in any way resembled prostatic tissue. Fig. 20 is a photograph of a specimen removed the same day as the previous specimen and shows the prostatic mass as removed in one piece. The small drainage tube occupies the position of the urethra and shows it distorted and the presence of the greatly enlarged median lobe which extends into the bladder and lifts the urethra up. The bladder in this case is to the right of the specimen. As one views the specimen grossly, it would look as if the entire adenoma were one piece. When, however, the anterior commissure is divided, the specimen falls apart and forms three distinct portions; the two lateral masses, which are the lateral lobes, are greatly hyper-

FIG. 18.



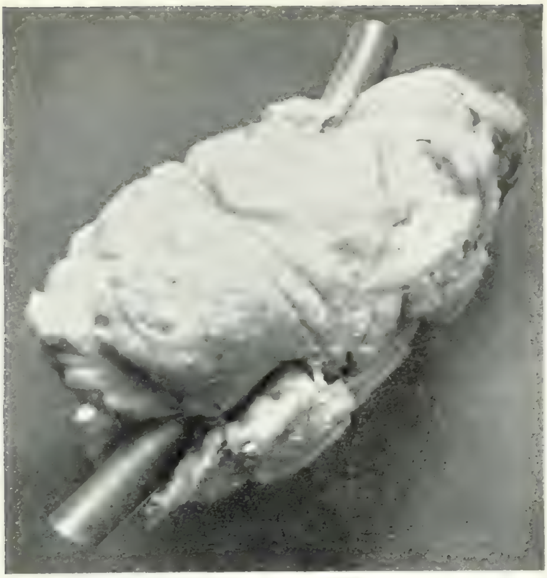
Specimen removed by transvesical operation, showing under surface in a case of enlargement of both lateral lobes.

FIG. 19.



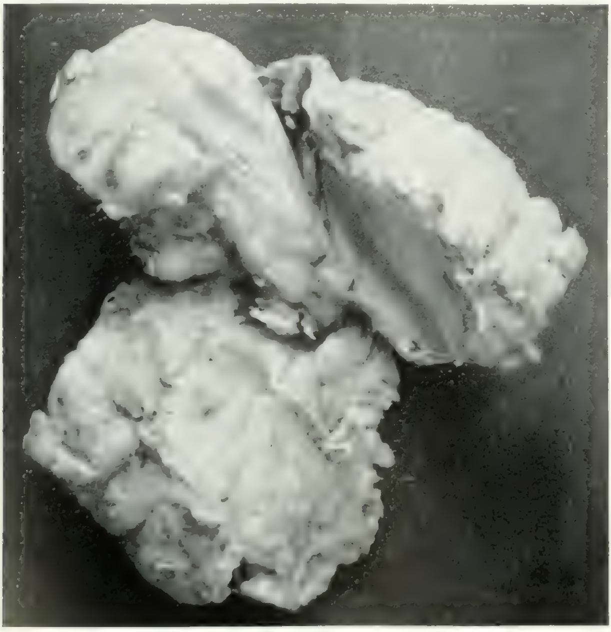
Same specimen as Fig. 18. The anterior commissure divided, showing two lateral hypertrophied lobes and the normal sized median lobe joining the two enlarged lobes.

FIG. 20.



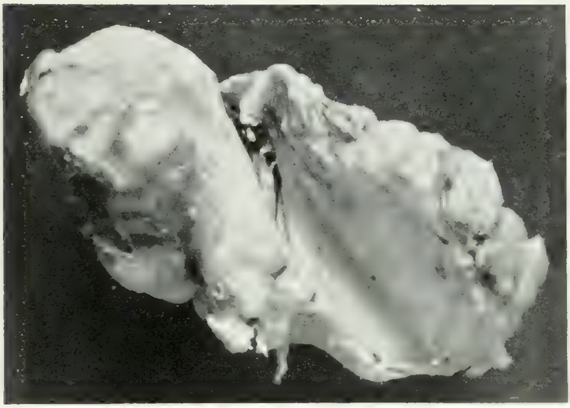
Specimen removed by transvesical operation showing the entire prostate removed in one piece.

FIG. 21.



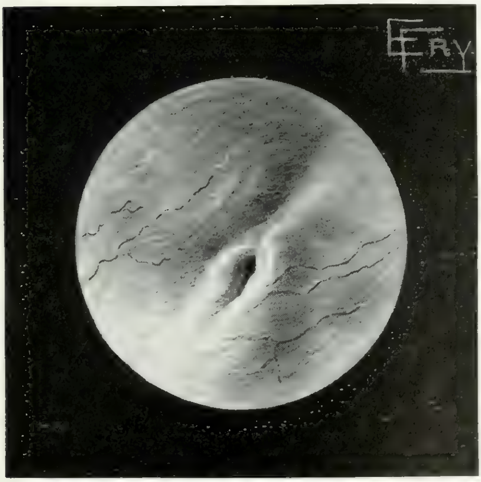
Same specimen as Fig. 20. The anterior commissure divided allowing the hypertrophied right lobe to drop down, showing the relation of the enlarged middle lobe and the left lateral lobe to the urethra. The middle lobe is seen to form the floor of the urethra for a distance of about one and one-half inches, but does not extend as far up on the urethra as the lateral lobe.

FIG. 22.



Same specimen. Shows this same condition more clearly.

FIG. 23.



A close view, through cystoscope, of a dilated ureter opening with lax walls.

trophied and compress the urethra, the course of which is indicated by the furrow (Fig. 21). To the left in the upper quadrant of the picture is seen the median lobe which extends well down into the urethra, well past the first portion of the lateral lobes, in fact, forming a wedge-shaped lobe between the portions of the lateral lobes which extend into the bladder. However, the specimen clearly shows the relations of the two lateral lobes to the urethra. Fig. 22 shows another view of this same gland which indicates more clearly the exact position of the urethra and its relations to the lateral lobes and to the median lobe. In this specimen one lateral lobe has been removed and the furrow, as indicated in the specimen, shows the relation of the urethra to both the lateral and median lobes. The lateral lobe forms the side wall for over two inches, while the median lobe, passing beneath the urethra, extends along it for an inch and a quarter.

Our own deductions are based primarily on an analytical study of our own cases, taking into account, first, the conformation of the prostatic mass as presented to the cystoscopist and judged by the eye, and the mass as found *in situ* at the time of operation and appreciated by the finger; second, a careful determination of the adenomatous mass in relation to the opening of the urethra and the sphincter vesicæ; and third, a thorough gross and sectional examination of all our specimens after removal by the transvesical route.

Professor Tandler has not demonstrated conclusively that the lateral lobes of the prostate are compressed and atrophied by enlargement of the anatomical median lobe. If he could show us the various stages of the development of this phenomenon by microscopical section, we would be convinced of his argument, but he has not presented any microscopical sections showing the transition from the adenoma involving the median lobe and atrophy of the lateral lobes. Furthermore, before we could accept his theory of the enlargement being confined only to the median lobe, it would be necessary to show that the ducts leading from this lobe were entirely distinct from the ducts leading from the lateral lobes.

II. THE CHOICE OF TREATMENT.

Assuming the diagnosis to be correct, that is, that obstructive prostatic disease exists, how shall we determine the course of treatment? And when the indication for prostatectomy is present, what is the safest procedure?

1. Palliative Measures.—The establishment of a catheter life, destroying an obstructing mass by using the cautery or punch, or the high frequency spark, are all but temporary expedients. Any and all of these methods may be used to insure the patient's temporary relief, but invariably the patient continues to become more enfeebled, is constantly the slave of his bladder, his mind is never at rest and finally, as a rule, he must face either an operation or death. Certainly this fact has been most forcibly demonstrated in the recent survey of our non-operated cases. These cases naturally fall into three classes, those in which the urinary obstruction is due to benign hypertrophy of the prostate, in other words, a chronic interstitial prostatitis; second, those cases in which the obstruction is due to carcinoma of the prostate; and third, tubercular hypertrophy of the prostate.

In the first class, in those cases in whom the obstruction has developed to that stage where the use of a catheter, either at intervals or every day, has become necessary to insure their comfort, infection sooner or later takes place, followed by sepsis, uræmia, etc., and the average length of life is less than three years. This is a little longer than the average time found in Squier's recently tabulated cases. All of this time, however, the patient lives in filth and misery and is a burden to himself and a trial to his friends.

In the second class of cases, the unoperated malignant growths of the prostate, no average can be stated which is of much value. The progress of cancer in the prostate is slow as a rule, but where there is much obstruction due to the growth, the combination of uræmia and the effects of the cancer often terminate the life of the patient within a year.

In the last 28 cases of benign hypertrophy of the prostate, which comprises all cases operated upon within the last two years, during which the new method hereinafter to be described has been followed, we have secured 100 per cent. recovery. In the malignant growths covering the same period, consisting of six cases, there has been one death. In this case besides removing the prostate, the base of the bladder and the seminal vesicles were also resected.

RESULTS.—*In the non-malignant cases* above mentioned the average length of life is limited by old age and the various ills incident to its progress. All of the cases have had full control of their urine and they have returned to their normal health again. *Of the malignant cases,* one patient is living two years and two months since his operation and is now showing marked cachexia, but is still able to void his urine without the use of the catheter. A second patient is living, one year and two months since his operation, with marked symptoms of carcinoma involving the rectum, but is still able to empty his bladder. A third case died 12 hours after the operation. A fourth is still living, four months after operation, with no symptoms as yet referable to the bladder; complete control and voids normally. The fifth case was operated upon two months ago; still no symptoms of return and voids normally. The sixth case is still in hospital making a good recovery. *One case of tuberculosis* of the prostate was operated upon in which the prostate was removed by this method. The patient recovered and is to-day perfectly well, one year and four months since the operation.

2. OPERATIVE CONSIDERATIONS.—*The chief indication.* If practitioners and surgeons will hold in mind the fact that *the chief indication is primarily to relieve the retention of urine rather than the removal of the prostate,* the entire subject of obstructive prostatic disease will assume a different aspect. If we could dissuade surgeons, as a rule, from the course of immediately taking out a prostate which is known to be obstructive, we would do much to help the cause of the prostatics.

There are two methods of accomplishing the relief of the retention of urine, and one of these two methods should comprise the first step in every operative encroachment upon the bladder for this disease. First is the use of an indwelling catheter which systematically drains the bladder for a definite period of time until the kidney has reacted from the changed condition. This method may also be used to clear up the cystitis. The second method is a suprapubic cystostomy and the introduction of a permanent catheter occupying the cystostomy wound for the same purpose as an indwelling catheter.

Before discussing the relative values of these two methods, one of which should always be employed before prostatectomy is considered, I wish to present a few facts which demonstrate that retention of urine in the bladder in prostatic disease has a very distinct and fundamental effect upon the general economy.

The Kidney as Affected by Prostatic Hypertrophy.— First, clinical evidence: The clinician will observe, in cases of prostatic disease in which there is considerable retention of urine, that the most marked symptoms will be evidences of intestinal stasis, loss of appetite, loss of sleep, changes in temperament, mental degeneration, lack of personal pride, loss of weight and a general deterioration of the entire organism. Aside from this, further examination will show various phases of uræmic poisoning; in many cases a very marked increase in the secretion of urine with low specific gravity. Frequently the amount of urine will reach 150 ounces in 24 hours and its specific gravity be as low as 1002. In a recent case the 24-hour record was over 300 ounces. This, of course, is an index of functional derangement of the kidney. The rapid disappearance of all these clinical evidences of disturbed renal function, which follows draining of the bladder, shows the direct relation of cause and effect.

We have both acute and chronic, partial and complete forms of obstruction.

In the cases of *chronic partial obstruction* it has been noted in general that the amount of urine secreted is increased, providing the bladder is strong enough to regularly overcome the partial obstruction, and partially empty the bladder so that at no time the back pressure from the bladder is continually great. Where the musculature of the bladder is not so strong, and there is a chronic retention of a considerable amount of urine with very little overflow, the amount of urine secreted will often average as high as 120 to 150 ounces in twenty-four hours with a low specific gravity.

Where we have a contracted bladder with greatly thickened walls, in which there is only a small amount of retention, and the amount of retained urine almost entirely fills the contracted bladder, the urine is passed very frequently and in small amounts. Such a bladder may contain only two or three ounces and is almost continuously full. Under such conditions the kidney seems to diminish its secretions. The total amount secreted in twenty-four hours may be very little, finally resulting in complete anuria.

The other cases are those of acute retention of urine, in which the kidneys act freely until the bladder is filled to its capacity, at which time the kidneys stop acting entirely. It must be remembered that the bladder will never rupture from overdistention due to accumulation of urine.

Aside from the clinical evidence of renal infection and renal insufficiency already presented, the most striking evidence of renal injury due to prostatic obstruction is presented in those cases dying from the disease. Autopsy shows a variety of conditions existing in the kidney, the lesion most common to all being a hydro-ureter beginning immediately above the bladder, resulting in various degrees of hydronephrosis and destruction of the kidney parenchyma. This in turn is influenced by the degree and duration of the obstruction and in more advanced cases is accompanied by infection, the formation of renal calculi, and, in some cases, by actual infection and destruction of the kidney parenchyma.[2]

To the mind of the writer those lesions are brought about by two mechanical conditions: 1. The hypertrophy of the muscular walls of the bladder through which the lower end of the ureter passes and, 2, the constant presence of residual urine which helps to keep the muscles compressed and forming a chronic obstruction extending over that portion of the ureter which passes through the bladder wall. It is the exceptional case in which the infection is an ascending one, but usually, in my opinion, it is due to hematogenous and lymphatic infection of a tissue whose resistance has been greatly lowered by mechanical obstruction.

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[2] Wade: Prostatism, Fig. 40. March ANNALS OF SURGERY, p. 334.

Second, objective symptoms: The cystoscope shows that many changes have taken place in the bladder. First, we note that the muscular walls are markedly changed. They are hypertrophied and trabeculated, and false and true diverticula are formed, and occasionally calculi of various sizes and shapes are seen. Occasionally, also, the infection of the renal pelvis which follows retention of urine predisposes to the formation of renal stones which may be shown on the X-ray plate.

The cystoscope, as a rule, shows the *ureter opening* raised up on a ridge with the interureteric fold quite distinct. The ureter opening in the majority of cases is normal with the exception that it is changed by the general muscular hypertrophy which surrounds it. Occasionally the ureter opening is dilated, as is seen in the accompanying illustration (Fig. 23).

Third, the operative proof: From a careful study of a series of cases in which a preliminary cystostomy was done, certain phenomena were repeatedly observed which seemed to justify us in dividing the sequelæ to advanced prostatism into three phases. It has further emphasized in our minds the peculiar balance existing between the heart, kidney, secretion of urine, and the nervous control of these in the patient who has gradually become used to over-distention of the bladder. The pathology of this condition has already been referred to.

We have learned not to rely upon any one clinical sign or symptom in judging the fitness of the patient for operation. We have learned that the balance between the various elements of the system are so adjusted that a disturbance of one element will bring to light weakness in some of the other elements which has not been suspected, for example, *the phthalein test.* This *may be very deceptive.* The patient may show 60 to 70 per cent. of excretion of phthalein in two hours before anything has been done to relieve the retention of urine. But disturb the retained urine in the bladder and all of the other elements of the system are thrown into confusion. The back pressure is relieved; decompression of the kidney follows; swelling and congestion of the kidney takes place; and the functional capacity of the kidney immediately drops to a very low point. The outward signs of the derangement of this unbalanced kidney are very evident. This is the second phase. It is our belief that many of the cases which have died following operation are the result of a lack of appreciation of this second phase of a renal disturbance in prostatics. Many deaths have been reported on the third to the fifth day following a one-step prostatectomy, when the patient was seemingly doing well; but when we add the phenomena of the second phase to the shock of the major operation with its loss of blood and the depressing effect of the general anæsthetic, it can be easily appreciated why these deaths take place, and many will agree that the overtaxed heart and the system overloaded with toxins which the kidneys should separate from the blood are the cause of death. Our extended observations have shown us that nearly every prostatic will present these three phases, and this fact has influenced us very greatly in favor of the two-stage operation in every case of benign hypertrophy.

III. THE THREE PHASES.

The results of our observations are graphically shown on the accompanying chart, Fig. 24, which shows the average condition which prevails in many advanced cases of obstructive hypertrophy of the prostate.

The First Phase.—For the first day, the day on which the suprapubic cystostomy is done, the blood-pressure frequently registers from 200 to 220 mm. of mercury; the urinary output for 24 hours will average from 70 to 120 ounces; the phenolsulphone-phthalein test will frequently average above 60 per cent. in two hours and the urine will show only a trace of albumin. If these conditions are considered by themselves, they will give us a false impression of the actual condition of the

FIG. 24.

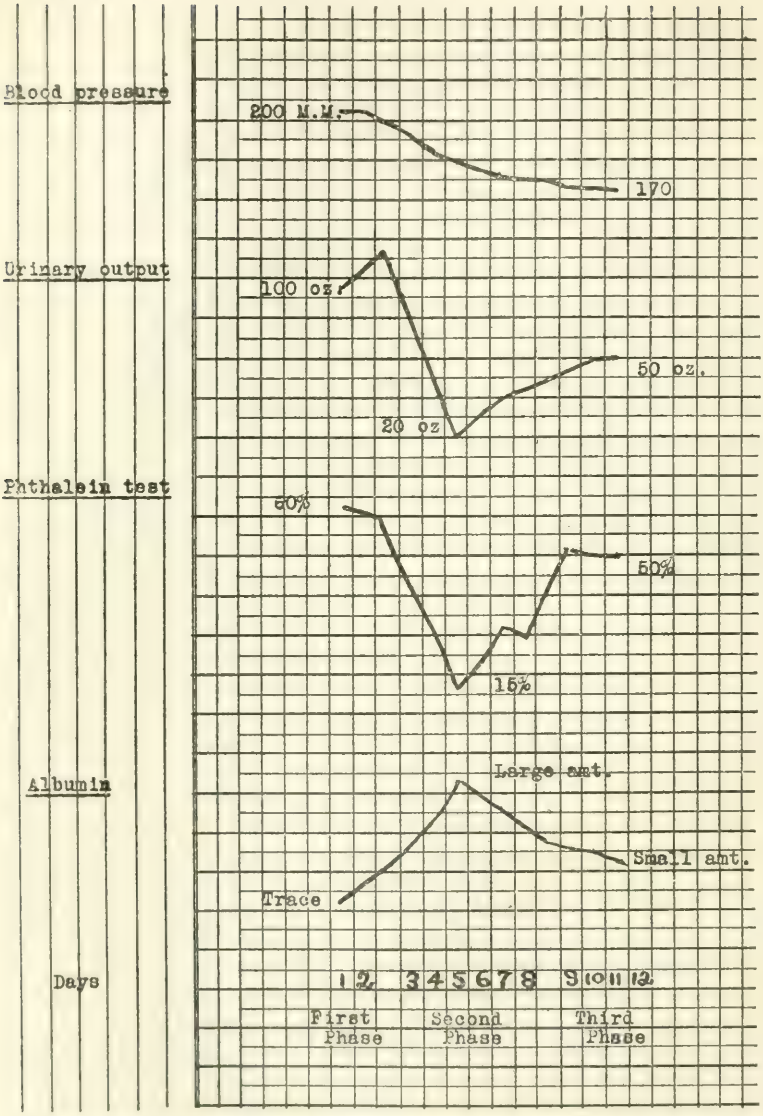

Chart showing the three phases following suprapubic cystostomy in an advanced case of obstruction due to prostatic hypertrophy.

First phase: Includes the first and second day, the suprapubic cystostomy being done on the first day. If one would observe this chart excluding the following days, the conditions would seem to be favorable for any operative encroachment. See page 514. If taken alone, this surely would seem to indicate a safe surgical risk.

Second phase: This phase extends over the third, fourth, fifth and sixth days after a suprapubic cystostomy. It shows a very marked decrease in urinary output during that time,

(Legend continued on next page.)

patient. For example, if the patient's blood-pressure registered 200, was passing 90 ounces of urine in 24 hours with low specific gravity and with only a trace of albumin, we would be rather suspicious of the functional capacity of the kidneys. But when we make a phenol-sulphone-phthalein test, and find that the output in two hours is 60 per cent. or more, it rather leads us to believe that the actual functional capacity of the kidney is greater than the specific gravity of the given specimen would lead us to believe.

The Second Phase.—A second glance at the chart will show a very different condition existing on the third or fourth day after the bladder has been opened and drained. Here we see a lowered blood-pressure, probably between 170 and 180. The urinary output has suddenly dropped to from 15 to 20 ounces in 24 hours; the amount of albumin in the urine has increased enormously and often the urine itself boils almost solid. On the third to fourth day, the phenolphthalein test shows the actual functional capacity of the kidney at this most critical time to be only *15 per cent.* This, then, is the change which has taken place simply following a suprapubic drainage of the bladder without any loss of blood or other surgical shock due to anæsthesia or prolonged manipulation. Add to this, then, the shock of a prostatectomy with its general anæsthesia, a very considerable loss of blood and the shock consequent to pain, and one does not wonder that so many cases have died on the third, fourth and fifth day from no apparent cause which could be demonstrated.

The Third Phase.—Passing on then to the third phase of

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a large increase in the amount of albumin present, but most important of all the drop in functional capacity of the kidney from 60 to 15 per cent.

Third phase: Showing the reaction and the recovery of the kidney after ten days. Blood-pressure 170, urinary output averaging 50, phthalein test 50 per cent., and a smaller amount of albumin present in the urine. Comparing this phase with the first phase we find a lower blood-pressure, a normal urinary secretion with an increased specific gravity, a lowered functional capacity of the kidney, as attested by the phenolphthalein test and a larger amount of albumin present in the urine than during the first phase. When, however, the reaction from this phase following enucleation of the prostate is considered, what a much better combination of circumstances exist in this phase than in the first phase. Following prostatectomy, the blood-pressure falls still lower, due to the loss of blood. The urinary output decreases most markedly during the first 24 hours, but recovers rapidly until, on the third day, it is practically normal. The phthalein test shows lessened reaction, but it never drops as low as was found in the second phase after suprapubic cystostomy, so that 50 per cent. according to the phthalein test in the third phase shows a very much greater relative functional capacity than 60 per cent. in the first phase. This we consider a point of very great importance. The amount of albumin following the operation is an unknown quantity.

the condition following drainage of the bladder, we find in the average case that on the seventh to tenth day the blood-pressure has decreased to from 160 to 170 mm., the urinary output has increased to from 40 to 50 ounces in 24 hours, the phenolphthalein test shows a reaction of the kidney from an output of 15 per cent. to an output of 50 per cent., and the amount of albumin contained in the urine has decreased very markedly, but still shows a small amount present, more than was present before the cystostomy and very much less in amount than was found on the third or fourth day.

Now if the prostatectomy is performed, the effect upon all these phenomena is quite different than was found after the preliminary cystostomy. The blood-pressure falls still lower, the urinary output decreases very little; the functional capacity of the kidney does not fall more than ten points; it is difficult to ascertain the amount of albumin present in the urine on account of the presence of the wound in the bladder, but at no time is it as great as was found on the third or fourth day after the cystostomy was performed.

By following this method we entirely avoid the second phase after the prostatectomy.

This conclusion is based upon the study of our last 28 successive cases, all of which have been operated upon after this method and all of which have recovered. It must be remembered that the second phase will last from a day or two to many weeks, and *if the reaction to the third phase does not take place within ten days to two weeks, the surgeon should not under any circumstances be persuaded to remove the prostate,* because if he does the chances are very much in favor of a fatal outcome. In one of our cases a gastric uræmia developed on the third or fourth day and *it was impossible to remove the prostate for over five weeks.* At the end of that time the third phase of the phenomenon appeared and the prostate was removed without any shock to the patient, followed by uncomplicated recovery.

All clinical observers naturally realize that the different stages vary in many cases as to their extent and their duration.

This point may best be emphasized by the following illustrative cases:

Case I.—*Diagnosis: Hypertrophied prostate; complete obstruction; vesical calculus; mitral insufficiency; chronic interstitial nephritis; double inguinal hernia.*

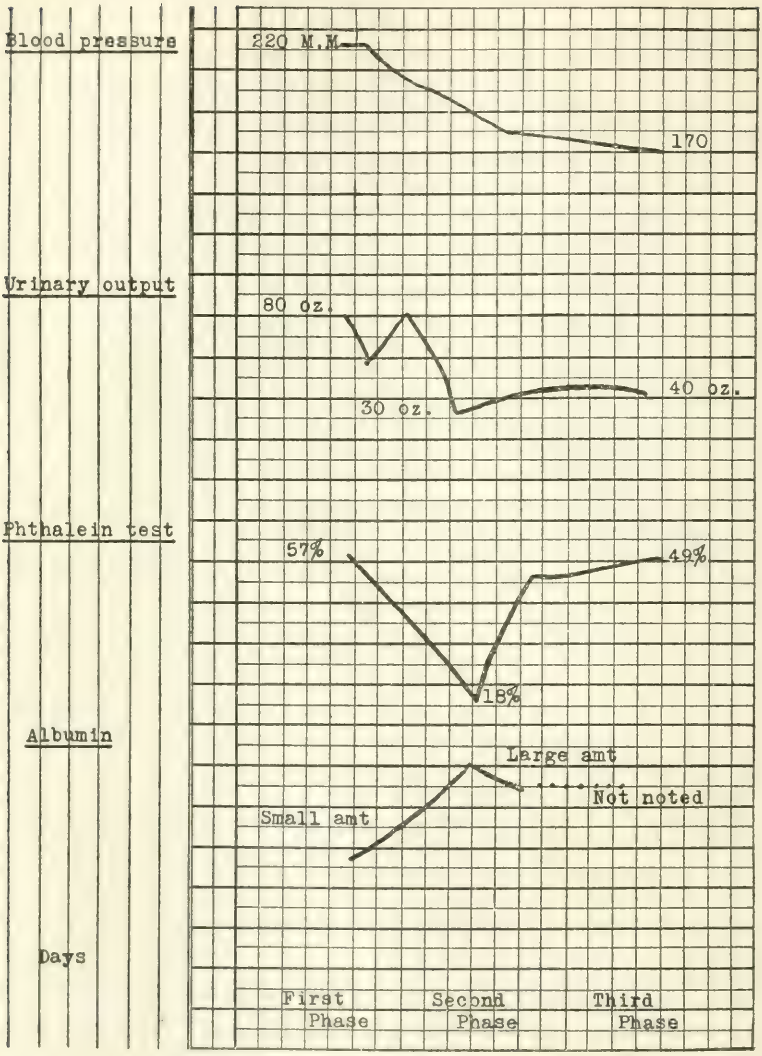
Condition on entrance to hospital July 14, 1913: A large framed man, *eighty-two years of age*, who has led an active seafaring life. For ten years has had increasing frequency of urination and for two years has used catheter daily for the removal of residual urine; *now depends entirely upon a catheter which he uses every four hours.* The use of the catheter is becoming increasingly difficult and painful and has already provoked several attacks of double epididymitis. There is present a moderate cystitis. There are evidences of a generalized *arteriosclerosis* with some *mitral insufficiency* and a moderate degree of *chronic interstitial nephritis.* He has also a *double inguinal hernia.* Notwithstanding these many physical defects, he still presents evidences of considerable vital force and, in the opinion of the surgeons, is a reasonably fair operative risk in the face of the marked urinary crises which are developing. Blood-pressure, 220 mm.; urinary output, 80 oz.; phthalein test, 57 per cent.; albumin, a trace.

First Operation.—On July 15, 1913, a preliminary suprapubic cystostomy was done by Dr. L. S. Pilcher under local cocaine anæsthesia, using 1 per cent. solution of cocaine.

The bladder was exposed in the usual manner without complaint from the patient. Upon opening the bladder a medium-sized *uric acid calculus* the size of a lima bean was detected and removed. A polypoid development of the middle lobe of the prostate perceived. A Pezzer catheter was secured in the bladder and the wound sutured. Patient sustained no shock from the operation. During the following week he remained very comfortable. Urinary output dropped to 30 oz.; phthalein test to 18 per cent., etc. (see Fig. 25). There was a gradual lessening in the blood-pressure and a notable improvement in his general well-being. A phenolphthalein test showed a steady increase in the renal activity.

Consulting the accompanying chart, Fig. 25, it will be seen that the blood-pressure had been reduced to 170 and the functional activity of the kidneys had reacted from the first period of depression. The patient's condition was very satisfactory, despite his

FIG. 25.



THE THREE PHASE CYCLE.

Chart of Case I. Showing the three phases in a patient 82 years of age. Note the marked difference between the three phases—especially the drop from 57 per cent. to 18 per cent. in the renal efficiency and the large increase in amount of albumin. Prostate enucleated during third phase. Recovery.

age of 82 years and his mitral insufficiency and chronic interstitial nephritis. It was, therefore, deemed proper to attempt enucleation of his prostate.

Second Operation.—Transvesical prostatectomy. Under ether anæsthesia, the finger was passed through the suprapubic opening and without removing any of the sutures the prostate was enucleated in three minutes. Some packing of the prostatic pouch was necessary to control a moderate hemorrhage. There was no shock following the operation. Draining tube and packing removed in 24 hours and a Pezzer catheter introduced. The Pezzer catheter removed on the fourth day followed by uninterrupted healing of the wound and full restoration of function. Six months after the operation the patient is quite well and is urinating normally.

It seems quite evident to us that it was safer ten days after the primary operation to remove the prostate than it would have been at the time of the primary operation. With the blood-pressure of 170 instead of 220, with the kidneys relieved of the disorganization incident to retention of urine, and with a well-balanced functional activity, the prostatectomy could be undertaken without danger to the patient. In our series of cases the depression which occurs from the third to the sixth day has been so constant that it is a real factor to be reckoned with in all these cases, and it is our belief that no prostate should be removed until this period of reaction has been passed.

In some cases the second stage lasts two, three, four or more weeks. During this period after the suprapubic cystostomy all of the clinical features of the case preclude the possibility of a prostatectomy and not until a fully developed third stage appears should the prostate be removed. The following case in which the patient developed a gastric uræmia, and massive œdema of the legs, will serve as an example.

Case II.—*Diagnosis: Obstructive hypertrophy of prostate; gastric uræmia.* The patient was admitted May 9, 1913. General health good. Considerable obstruction. No symptoms of kidney trouble excepting a slight amount of albumin which was present.

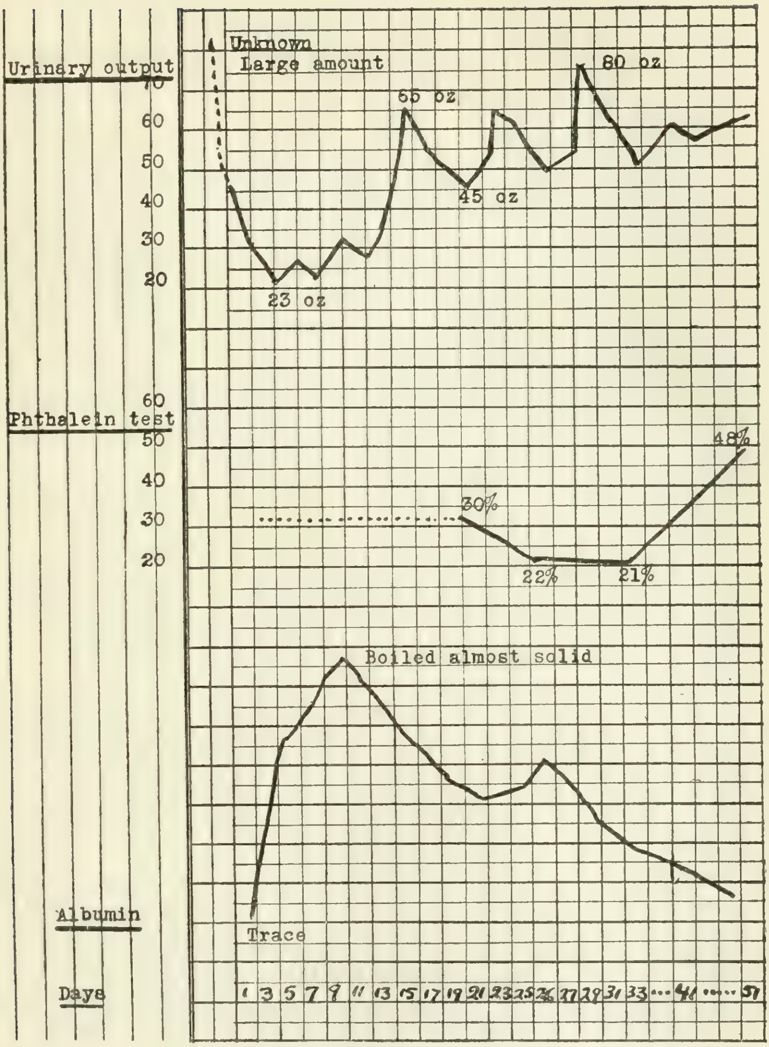
First Operation.—Suprapubic cystostomy; Pezzer catheter. May 10, 1913, operation quickly accomplished under local anæsthesia. The day following operation passed 24 ounces of urine, clear, large amount of albumin present; 26 hours after operation began to vomit; 8 hours after operation hiccoughs began and continued intermittently for 24 hours. Second 24 hours urinary output dropped to 27 ounces, still clear; vomiting continued; urine almost solid with albumin. Third 24 hours some nausea, no vomiting. Fourth 24 hours vomiting recommenced. Hiccoughs lasted for 14 hours, quite restless. Urine became bloody, almost solid with albumin—29 ounces in 24 hours. Fourth day very sleepy, hiccoughs continuing, legs showed slight swelling, urine bloody. Fifth day slight hiccough, urine clearer, sat up. Patient showed a gradual improvement with the exception of the swelling in his legs, which increased so that both legs soon became very badly swollen.

Coincident with this no phenolphthalein test was made on account of the large amount of blood and albumin present. June 2, phenolphthalein test showed 30 per cent. excretion the first two hours; June 9, one week later, showed 22 per cent. excretion first two hours; June 15 showed 21 per cent.; July 1, phenolphthalein test showed the excretion to be 48 per cent. in two hours. The patient's general condition showed a coincident improvement, swelling of the legs entirely disappeared, the amount of albumin in the urine very greatly decreased so a further operation was deemed advisable.

Second Operation.—Transvesical prostatectomy. July 5, 1913. Suprapubic catheter removed and with the finger passed into the bladder through the suprapubic opening the prostate was easily removed. There was considerable hemorrhage which necessitated the introduction of packing. Reaction from the operation was very slight. Twenty-four hours after operation was sitting up in bed; 48 hours after operation the drainage tube was removed from the wound and Pezzer catheter re-inserted; 59 ounces were collected through this catheter during the 24 hours, with hardly any leakage. On the fifth, sixth and seventh days he evidenced some stomach irritability and vomited a little, but the attack passed off quickly. On the ninth day began to urinate a little. Wound healed promptly and the patient was discharged cured August 2.

It is not only the kidney and its function which must be considered, but it may be that it is the heart that is the weak link in the chain, and in order to ensure a safe operation the

FIG. 26.



THE THREE PHASE CYCLE. PROLONGED SECOND STAGE.

First phase: Aside from the large amount of urine passed, the patient's condition was almost ideal.

Second phase: Which followed the suprapubic cystostomy was unusually severe. Marked diminution in the amount of urine. Urine boiled almost solid. Gastric uræmia supervened. Enormous swelling of the legs. Patient in desperate condition. At the end of 51 days, however, all of the uræmia symptoms had disappeared. Amount of urine passed was normal.

Third phase: At end of 50 days phthalein test showed 48 per cent. Urine showed very small amount of albumin. Patient's general condition satisfactory. Prostate enucleated with hardly any post-operative reaction. Patient made perfect recovery.

kidney must be in the best possible condition before the enucleation is undertaken, for if, with a failing, dilating heart the renal function fails, there is little hope for the patient's recovery. The following case illustrates this point:

CASE III.—(Lynch.) Patient was a man whose actual age was sixty-five years although his appearance was that of a man of about eighty. For two years he had been struggling against the ravages of prostatic disease and had gradually become emaciated. Was rapidly losing his strength and had already lost his appetite. He had been catheterized frequently, but this had ceased to give relief and at the time of his examination was passing his water every 15 to 20 minutes day and night. As the result of a metal instrument being passed into the urethra he developed an acute retention with bleeding into the bladder. When seen by me he was in greatest distress and the bladder dilated up to the umbilicus. His pulse was small and weak. He was in considerable shock.

First Operation.—Suprapubic cystostomy. He was hastened to the hospital and immediately the bladder was opened under local anæsthesia, and a large amount of blood clot and urine were brought away and a Pezzer catheter sutured into the bladder and the wound closed around it.

The patient reacted very well from the operation. The following day his temperature reached 102°, his pulse 100, urinary output averaged 25 ounces. Renal sufficiency as shown on accompanying chart, which was 69 per cent. of phenolphthalein excreted during the first two hours immediately after the operation, dropped on the third day to 20 per cent. in two hours under the same conditions. His pulse was weak and soft but not very rapid. His general condition was good. One week later the phenolphthalein test showed an elimination of 48 per cent. in two hours (Fig. 27). Two days after this, when examined, his condition was considered proper for operation, and under ether anæsthesia this was accomplished.

Second Operation.—Enucleation of prostate. Time of enucleation 1½ minutes. Control of hemorrhage, which was considerable, by packing as above described. The day following the operation patient's condition good. Packing and drainage tube removed. Pezzer catheter inserted. Urinary conditions good. On third and fourth days very considerable cardiac insufficiency, pulse extremely weak, intermittent and general weakness (see chart, Fig. 28); temperature 101.8°, pulse 130, respirations 40. Under

FIG. 27.

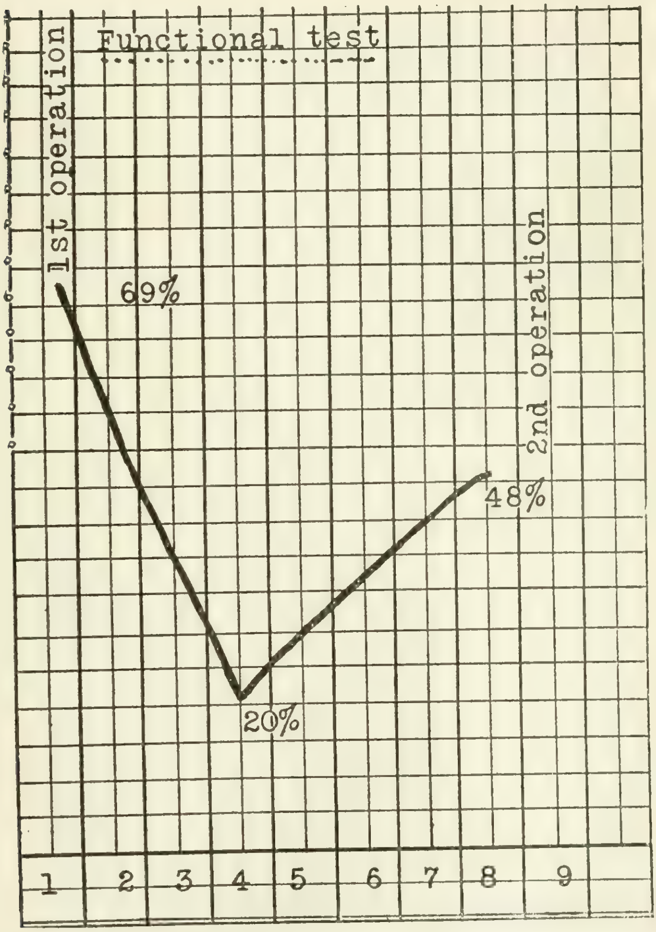


Chart showing drop in renal function during second phase from 69 per cent. to 20 per cent. (Case III.)

proper medication the conditions gradually returned to normal, which they reached on the fourth day. However, this chart will show the dangerous reaction following the operation which, if it had occurred coincident with the shock of the primary operation

Fig. 28.

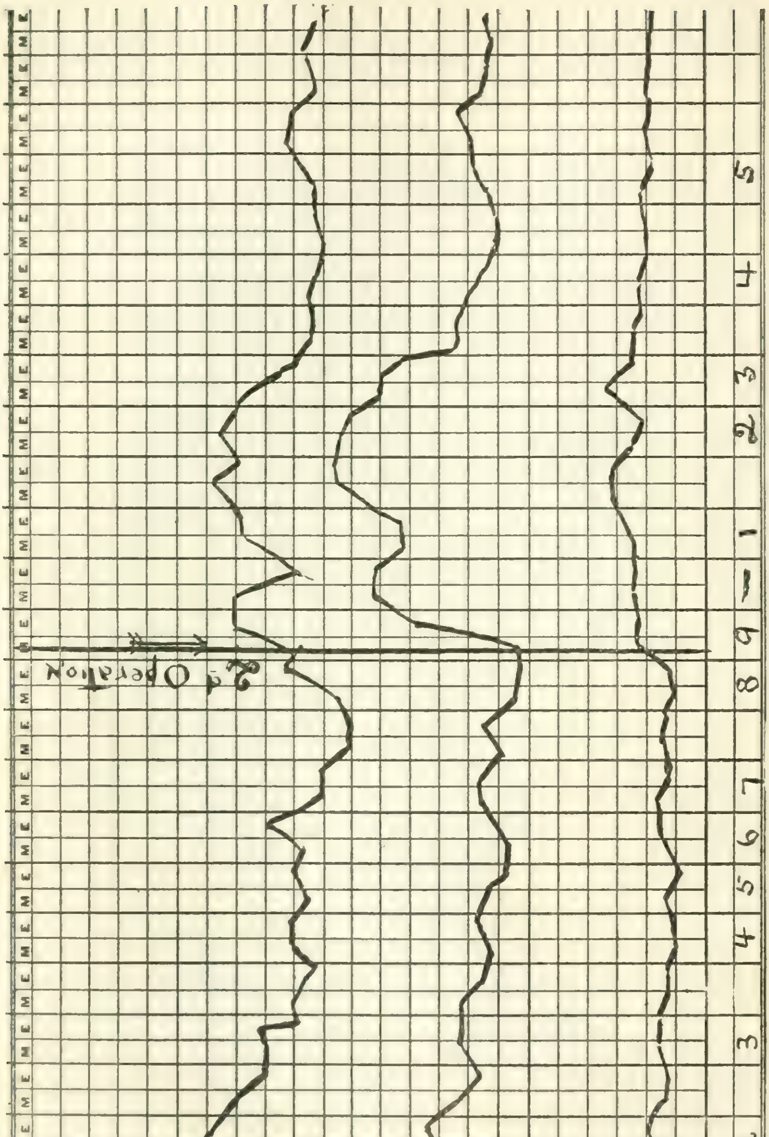


Chart showing pulse, temperature, and respiratory conditions in Case III.

with a very marked decrease in the renal sufficiency, the patient would probably have died on the second or third day. As it is the patient recovered entirely; he passed his urine by the urethra on the ninth day, and the wound was closed completely on the twenty-second day. His present condition is satisfactory.

As already referred to, in cases of enormous dilatation of the bladder with œdema of the legs, scrotum, etc., the three-phase cycle shows a remarkable curve when traced on the chart. The accompanying diagram, Fig. 29, shows the condition existing in a patient still under our care. During the first 24 hours the patient passed 249 ounces of urine, a catheter being used to withdraw the amount in small quantities and never emptying the bladder, that viscus being continuously dilated as high as the umbilicus. On the second day more urine was withdrawn at a time and the urinary output was 308 ounces, specific gravity 1002. Following the chart it will be seen that gradually the urinary amount decreased and that on the fourth day the bladder was completely emptied for the first time by catheter, the amount passed during the 24 hours being about 120 ounces. This modified second phase shows a preliminary rise and the enormous output of urine would unquestionably have overwhelmed the patient had a prostatectomy been done, or even a suprapubic cystostomy.

Fig. 30 is the pulse chart of the same patient and shows the remarkable effect the condition had upon the action of the heart. On the twelfth day the phthalein test showed a 40 per cent. output, but the pulse was extremely unreliable. Five days after the suprapubic cystostomy the phthalein test showed an output of 67 per cent. and the pulse at that time would not permit a prostatectomy. In fact, with a heart so badly damaged and a kidney which had been exposed to so much pressure, the date of the prostatectomy must be put off for some weeks.[3] Other cases show only a mild degree of depression in the second phase and it would undoubtedly have been perfectly safe to remove the prostate at the first operation, but as yet I have not

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[3] Thirty-eight days after the cystostomy the prostate was removed and the patient has made a good recovery.

FIG. 29.

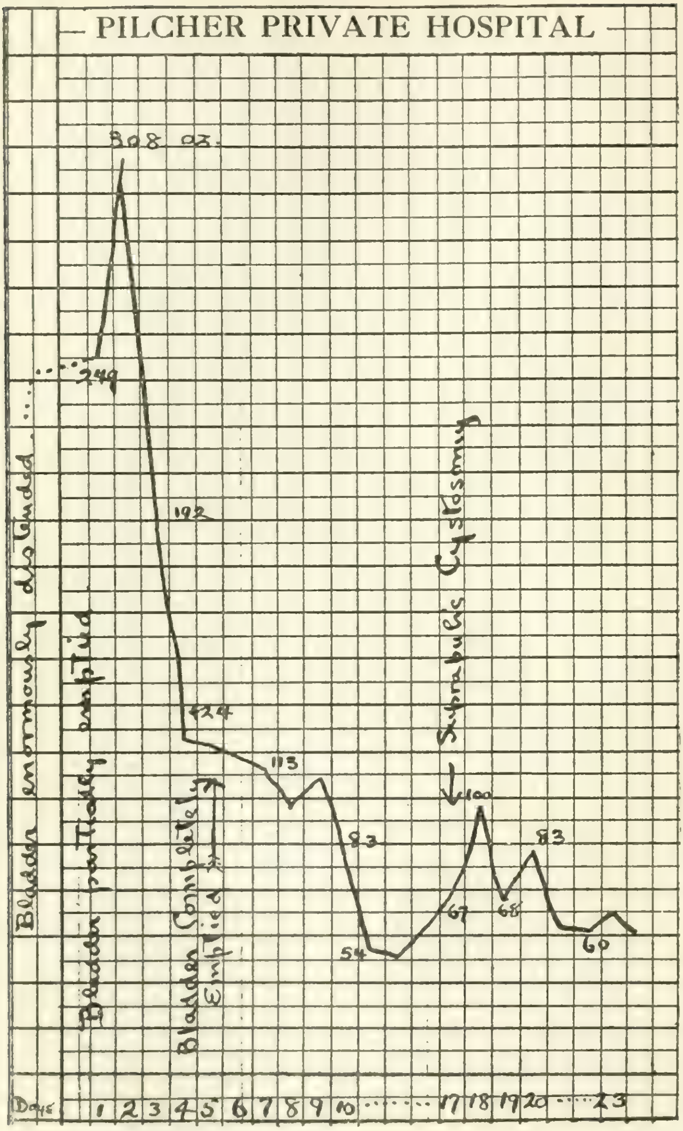


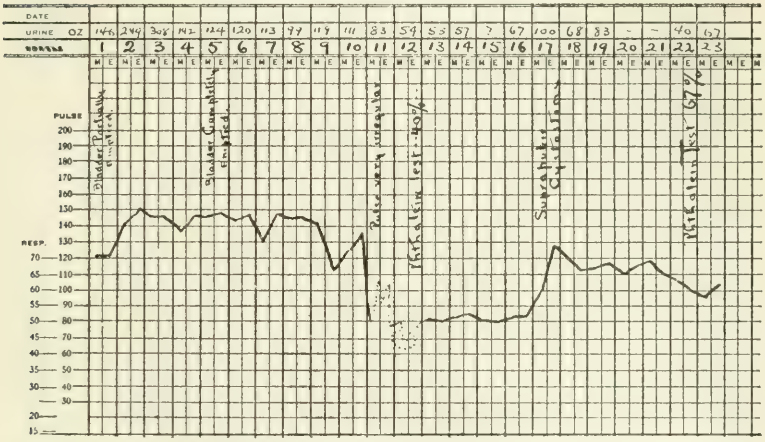
Chart showing remarkable first phase of chronic prostatism. Bladder distended above umbilicus. Patient in collapse. Partial decompression of kidney developed urinary output of 308 ounces of urine in 24 hours. The second phase showed a gradual drop in urinary output, with a very marked increase in the amount of albumin. Suprapubic cystostomy on twelfth day showed very slight reaction from kidney. For the first twelve days, urine was removed by catheter.

been able to tell which cases fall within this class until after the cystostomy has been performed.

How shall we decide, then, when it is safe to remove the prostate in a given case?

First, our judgment is based on the general condition of the patient. When his appetite returns and his sleep becomes normal, when his temperature, pulse and respiration are normal, and when the renal output has returned to normal limits, we consider these a fair index of the general physical well-being of the patient.

FIG. 30.



Pulse chart of same patient whose urine chart is shown in Fig. 29. Partial emptying of the bladder caused pulse to rise to 150 beats per minute. On the eleventh day heart action changed suddenly, as indicated on the chart, and its rhythm and rate were very irregular. The heart balance was gradually established and the suprapubic cystostomy did not disturb it very much.

Second, we do not advise prostatectomy until all the gross uræmic and nephritic symptoms have disappeared. A moderate amount of albumin in the urine is no contra-indication. The condition of the blood-pressure is also a valuable index.

Third, the phenolphthalein test is of value only as taken in connection with other signs. In the first place, one must consider the results of the phthalein test before the preliminary cystostomy; then the phthalein test taken on the second, third or fourth day, and third, the functional reaction of the kidney to this test at the end of a week or ten days. It is a mistake to rely entirely upon this test, especially before the cystostomy has been done. For example, the test may show excretions of more than 50 per cent. in the first two hours before the preliminary cystostomy, but the reaction may drop on the second or third day, after relief of the retention of urine, to below 15 per cent., which is a true index of the functional capacity. When, however, the period of depression is passed and the reaction returns to 50 per cent. after the retention of urine has been relieved, this then becomes a fair index of what we can expect the kidney to do after the prostate has been removed.

CATHETER DRAINAGE OF THE BLADDER.—There are some cases in which catheter drainage of the bladder must be used as a preliminary to the suprapubic cystostomy, such as cases where there is an enormous distention of the bladder with œdema of the legs, scrotum, and penis due to pressure. If a cystostomy is done and all of the urine is withdrawn at one time from the bladder, the shock and decompression of the kidney thus occasioned may bring on a fatal uræmia or a fatal hemorrhage. One such case was seen by the writer at the Jewish Hospital in Brooklyn where the bladder, which was enormously distended, was suddenly emptied; the patient promptly died. A second case under the care of the writer at St. John's Hospital, in which 72 ounces of urine was withdrawn from the bladder, was followed by a dangerous hemorrhage into the bladder.

1. *Indications for Catheter Drainage.*—Some operators prefer to use catheter drainage for a week preparatory to every transvesical prostatectomy. It is always indicated in cases where the residual urine amounts to 30 ounces or over.

2. *Dangers.*—Sudden withdrawal of all of the urine may cause death from shock, uræmia or hemorrhage. The presence of a catheter in the urethra may occasion infection, and in a number of reported cases death has followed its use.

3. *General Rules.*—If catheter drainage is established, the bladder should not be emptied all at once, but the urine grad-

ually withdrawn and, depending upon the amount present and the amount secreted by the kidney, the amount drawn should be regulated.

It is an interesting fact that the control of the amount of residual urine in cases of enormous distention of the bladder will regulate the output of urine through the kidney. In connection with these cases no drugs should be given to stimulate the heart or change its action until there is some very absolute indication for the same, for harm may be done, preventing the establishment of a normal balance, as the heart adjusts itself to the new conditions found in the kidney.

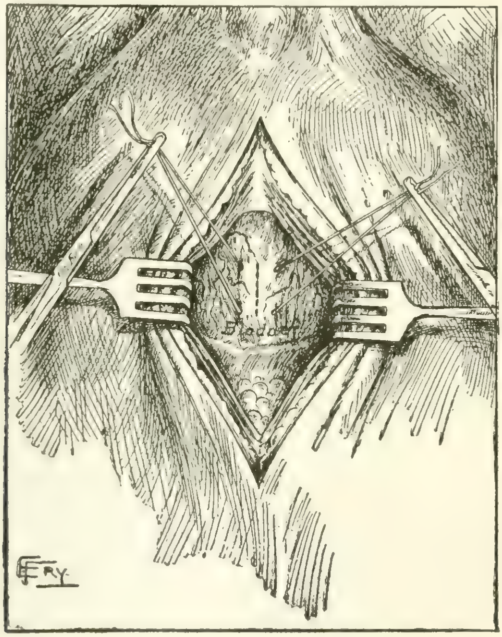
IV. SUPRAPUBIC CYSTOSTOMY.

First step, preparation of the patient. Skin, usual iodine preparation. Anæsthesia, novocaine 2 per cent. by preference. Incision, vertical.

Technic of Operation.—Usual incision beginning just above the pubis is made through the skin and superficial fascia. The sheath of the rectus is divided in the median line, the recti muscles are separated, exposing the prevesical fat and fascia. The muscles are held apart by a specially devised retractor, modified from the Mayo-Collins appendectomy retractor. The advantage of this retractor is that the curved blades are in a straight line at the point where they enter between the muscles, and after they are entered they present a concave surface to the muscular face which they wish to retract, which keeps them from slipping out of the wound. Then the third arm of the retractor is placed later. When the prevesical space has been exposed, the finger is entered until it reaches the superior surface of the symphysis. With this as a landmark, the finger covered with gauze is used to strip the fascia and lymphatic tissue from the anterior wall of the bladder. It is often of advantage to have the bladder partially filled with water, for then it is somewhat easier to clean off the anterior surface of the bladder with the finger. This stripping away of the tissue with the finger is carried up to the peritoneal fold. The peritoneum is not disturbed unless it reaches far down over the anterior surface of the bladder. If this is so, the peritoneum is stripped up somewhat. With the bladder surface freely exposed, the third arm of the retractor is placed over the bit of gauze to hold up the fat covering the peritoneal fold.

Securing the Bladder.—To hold the bladder in place a silverized catgut retention suture is passed through the wall of the bladder near the point at which the bladder is to be opened (Fig. 31). The water is then withdrawn from the bladder through the catheter and the bladder washed clean. Then holding the wall of the bladder out through the abdominal wound, a knife is thrust into the bladder. The knife is withdrawn and the finger enters the bladder and examines the interior of the bladder to determine the presence of stone or

FIG. 31.



Second step in the preliminary cystostomy. The bladder wall is seen exposed and the position of the incision is indicated near the fold of the peritoneum. The two stay sutures are in place and hold the bladder wall up. As soon as these sutures have been introduced the fluid is withdrawn from the bladder.

any foreign body. A foreign body, if present, is then removed. The condition of the prostate and its conformation and general character is then studied with the finger. The only point at which the patient will complain of pain is when dragging on the bladder wall or when examining the bladder with the finger through the bladder wound. Examination of the interior of the bladder can be done quickly. The finger is then withdrawn and a Pezzer catheter is inserted into the bladder wound (see Figs. 32 and 33).

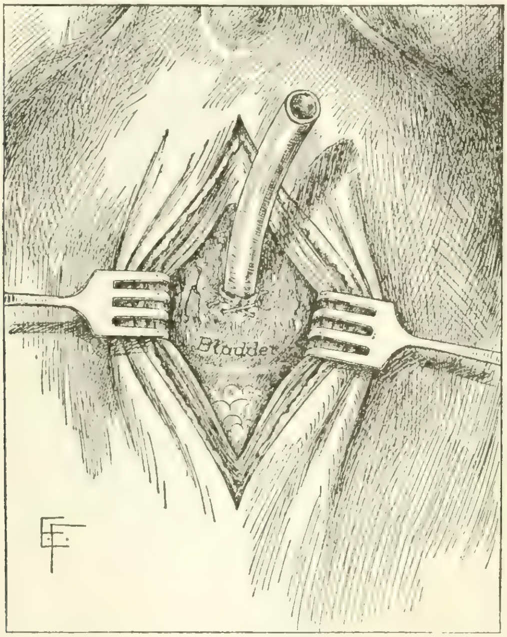
The Point at Which the Bladder is to be Opened.—Incision into the bladder is made as near the peritoneal fold as possible, for healing takes place more rapidly at this point, and when a fistula is formed, the urine enters the fistula less easily at this point.

Draining the Bladder.—The Pezzer catheter, as mentioned before (Fig. 33), is fixed in the anterior wall of the bladder, then, using the same suture that was placed for the retraction suture, a purse-string is made in the bladder wall around the catheter. This suture is of catgut. It is tied, being careful to tuck in the muscular wall of the bladder around the catheter. This produces a slight spur in the interior of the bladder which, after the catheter is removed, favors early healing. This suture when tied insures a water-tight joint around the Pezzer catheter. The wound is then reconstructed. The prevesical space is carefully obliterated by the catgut suture. The fascia and muscles are sutured together with chromic gut. The skin is sutured with silk. In other words, all of the planes of tissue are brought together again in their natural position and the only opening is the line through which the catheter emerges. It is possible to do this in these cases because the joint around the Pezzer catheter is water-tight and there will be no leakage for over a week. The result is that *we have a primary union of the wound, a thoroughly drained bladder and the first step of our transvesical prostatectomy already completed.*

In any transvesical prostatectomy most of the time will be consumed in making the suprapubic incision and in closing the same. By this method this step of the operation is already completed before the prostatectomy is attempted.

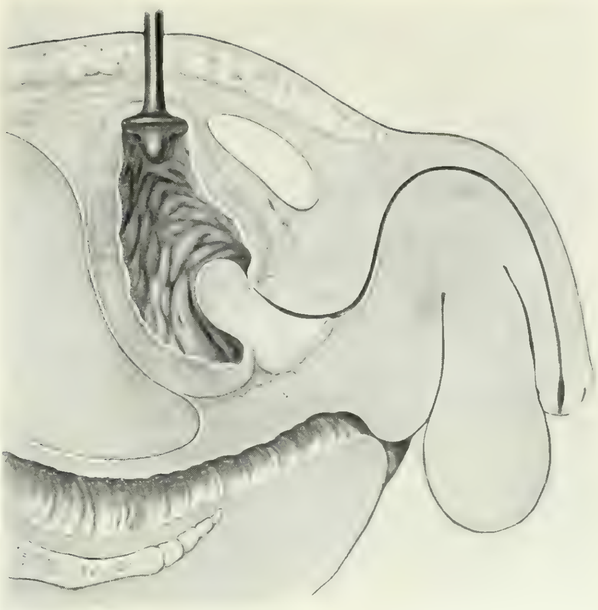
Whatever shock is going to take place from this encroachment on the urinary apparatus in cases of prostatic hypertrophy will become evident on the second to the fifth day after the suprapubic cystostomy. The *patient is in the best possible condition to overcome this shock because there has been no loss of blood, no general anæsthetic,* and *no special pain,* all of which factors tend to decrease the resisting powers of the organism. Almost without exception in cases where there has been any great retention, there is a marked renal reaction which occurs during the first week, as previously noted. If this, then, can be eliminated as a factor of the prostatectomy itself, it seems to us that it is our duty to do this.

Fig. 32.



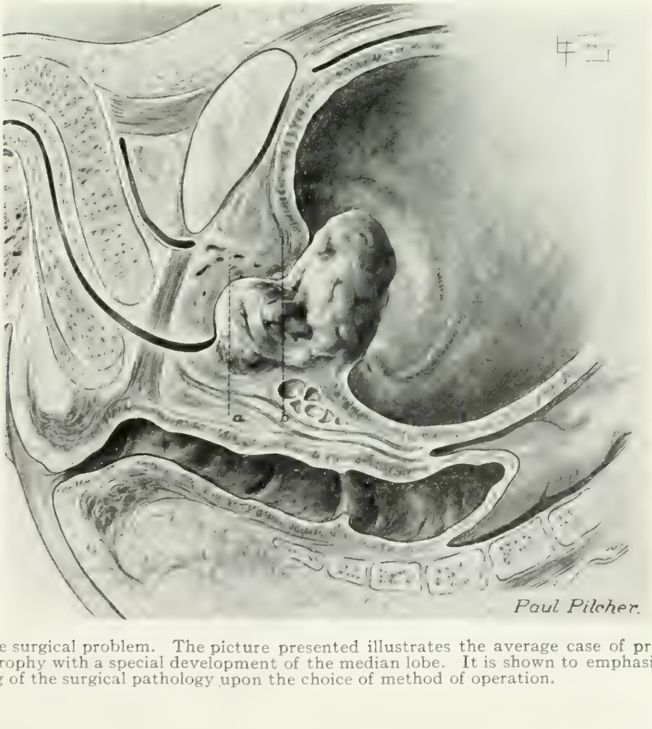
Shows the way in which the Pezzer catheter is fixed into the bladder wound,—the stay suture from one side being tied on the opposite side of the tube including some of the bladder wall, and the one from the other side tied in a similar manner. These will hold the tube firmly in place. A purse-string suture is used for the same purpose.

Fig. 33.



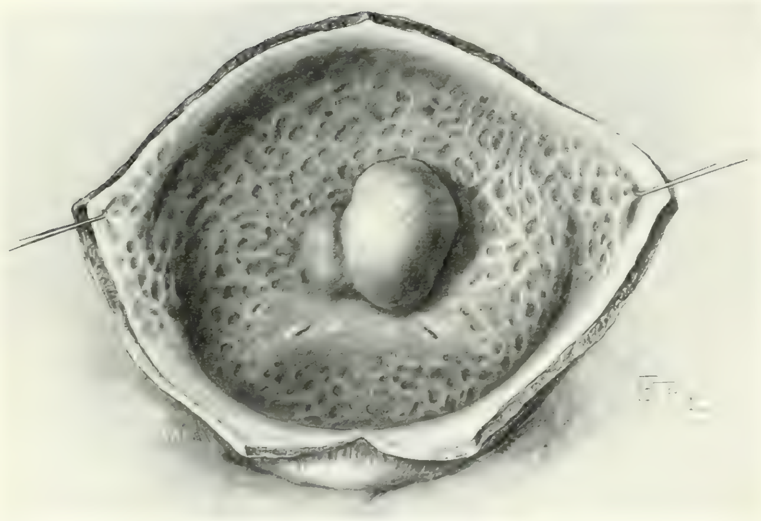
Pezzer catheter in place after suprapubic cystostomy. Button of the catheter fits snugly and is far superior to the ordinary drainage tube inasmuch as it does not permit any rough or sharp surface to irritate the prostate or the bladder wall. This idea was first suggested to me by Rovsing and is the method which he follows.

Fig. 34.



The surgical problem. The picture presented illustrates the average case of prostatic hypertrophy with a special development of the median lobe. It is shown to emphasize the bearing of the surgical pathology upon the choice of method of operation.

FIG. 35.



Illustrates a second view of the vesical aspect of a hypertrophied prostate showing the irregularity of the outgrowth and emphasizing the fact that the prostatic hypertrophy is a lesion of the bladder and not of the perineum.

Two other methods have been devised as the first step of the transvesical enucleation. First, the use of a permanent catheter. This question has already been discussed (p. 528). The objections to it are: In the first place, it is most disagreeable to many patients; in the second place, it almost invariably excites a urethritis which frequently causes an infection of the epididymis, and sometimes affects the testicle. These are unfortunate complications. In the third place, fatal sepsis has more than once followed the using of a permanent catheter in old men with prostatic disease.

One method used as a substitute for the suprapubic cystostomy in emergency cases is the puncture with a trocar above the pubis. This is not without danger in the hands of some surgeons, to say the least, and it does not in any way shorten the major operation.

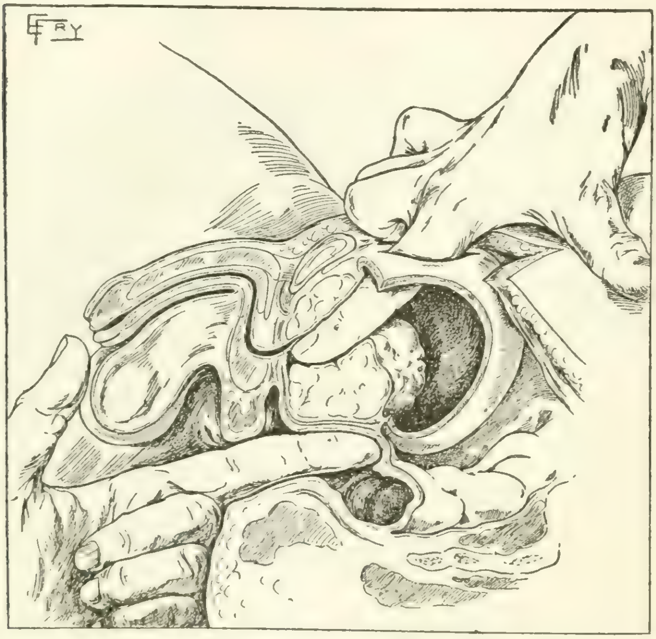
My chief argument, however, is that by doing a preliminary suprapubic cystostomy we accomplish everything that any of the other methods do; we are able to do it under a local anæsthetic; we have exposed the suprapubic tissues to infection and, if this takes place, which is a very rare occurrence in these cases, it may be overcome and will subside before enucleation of the prostate is undertaken. Again, as the result of the preliminary cystostomy, the œdema and swelling around the neck of the bladder, including the prostate, greatly diminish. I have seen the prostate diminish one-half in size after the suprapubic cystostomy alone. This is of advantage in the enucleation and the healing of the wound.

V. THE TECHNIC OF TRANSVESICAL PROSTATECTOMY.

When it has been proven to the surgeon's satisfaction that the prostate can be safely removed, judging from the functional test of the kidney compared with the original functional test and taking into account the amount of urea excreted and the evidences of acute or chronic renal disease, as well as the general condition of the patient, as previously stated, the operation may be undertaken. The patient is prepared as for any other operation. When the dressings are removed, after the preliminary cystostomy using the Pezzer catheter, it will be found that the wound surrounding the catheter has healed by primary union. *The silk sutures are still in place. These are not removed,* for they are needed to hold together the recent wound while the finger is enucleating the prostate.

First step: The skin is prepared with iodine. The Pezzer catheter is removed and the *gloved finger* introduced into the bladder through the suprapubic opening. This opening easily dilates sufficiently to allow free manipulation of the finger. The index finger of the other hand is introduced into the rectum and the prostate is lifted up.

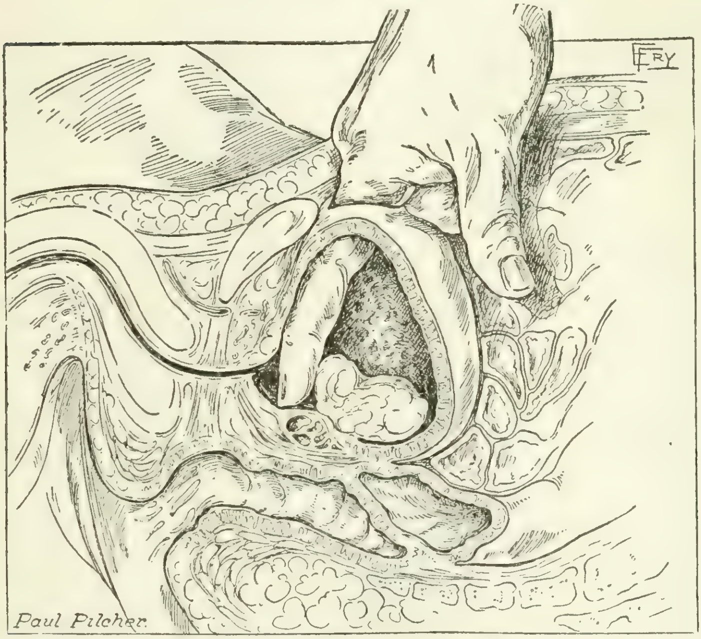
Fig. 36.



Transvesical prostatectomy. Enucleation of the prostate. Usual method. Finger is introduced into the urethra and advanced as far as possible before breaking through the urethral mucous membrane. Usually the line of cleavage is easily found from the urethra and the enucleation is accomplished as described in the text.

Second step: Enucleation of the prostate. The index finger of the enucleating hand is introduced into the prostatic urethra and advanced as far as possible, reaching, if possible, the furthest point of the prostatic enlargement. This method, as shown in Fig. 36, is especially useful in two forms of prostatic enlargement, that which is due to an irregular enlargement of both lateral lobes, and that which is due to enlargement of both lateral lobes and the median lobe, even though the median lobe be enlarged out of all proportion to the other two lobes, as in Fig. 3. With the finger in the prostatic urethra, the point of least resistance in the mucous membrane of the urethra is sought. Usually this will be found on the lateral or the anterolateral wall of the urethra. At this point the division between the prostate and the urethra is usually quite easily broken through. In all of my recent cases I have been able to gain the line of cleavage through the urethra easily with the gloved finger. The finger after entering the line of cleavage sweeps, first, slowly around the distal portion of the growth, and then, up over the anterior surface of the growth separating it from

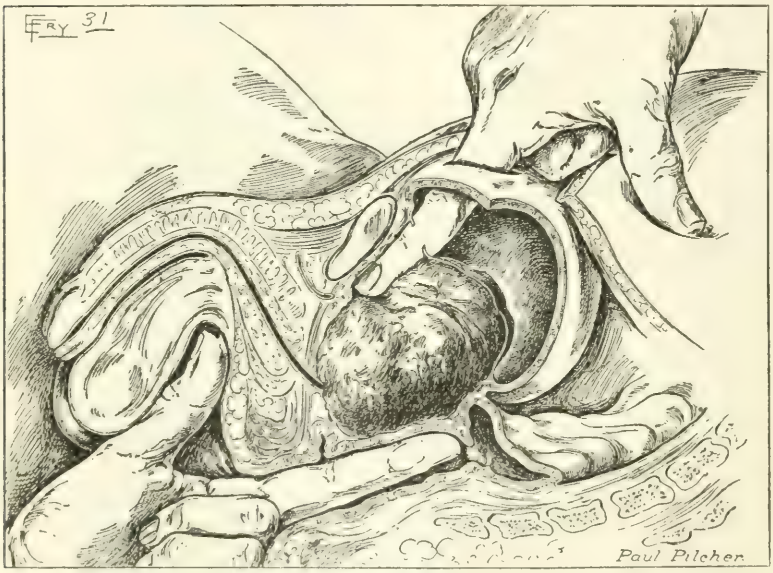
Fig. 37.



Drawing illustrating one of the final steps in enucleation of the prostate. The lateral lobes have been freed and the mass together with the median lobe is being turned over and turned into the bladder, stripping up the mucous membrane of the bladder from the surface of the prostate.

the prevesical tissue. The finger is then passed across the urethra to the other side with a sweeping motion of the finger and the opposite lateral lobe is freed. Then passing the finger up over the entire mass an attempt is made to turn the growth over so that it will easily turn out into the bladder carrying with it the median lobe (Fig. 37). That is to say, the finger is passed up over the two loosened lateral lobes and then beneath the same between the enlarged lobes and the rectum, and then the finger is pulled toward the bladder so that the growth will turn upon itself, as is shown more clearly in Fig. 37.

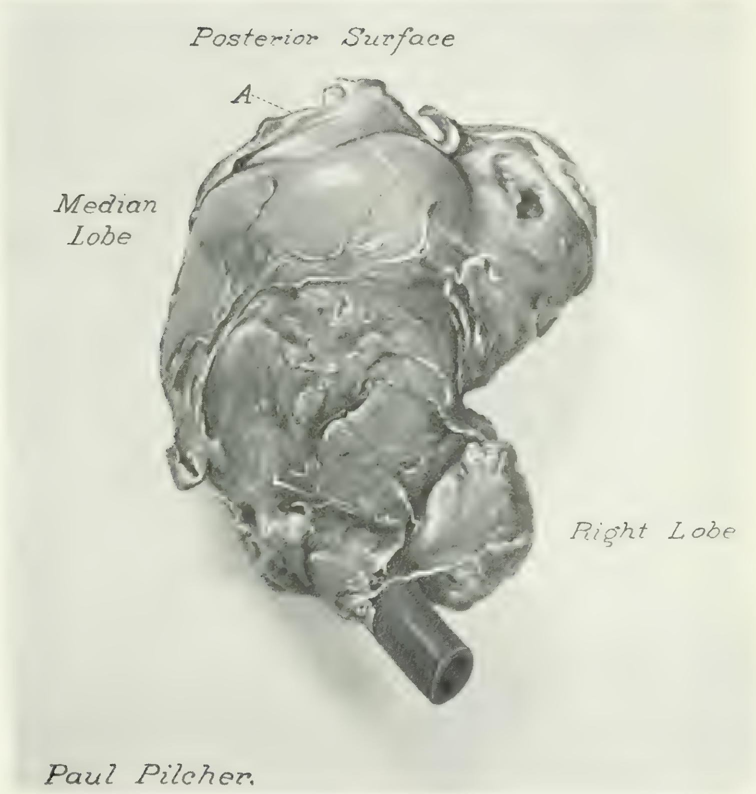
Fig. 39.



Drawing illustrating method of removing a massive hypertrophy of the prostate where the urethral enucleation is impracticable. This is applicable in the large bilateral hypertrophies. The illustration shows the finger raising up the sphincter, enucleating the prostatic mass in one piece.

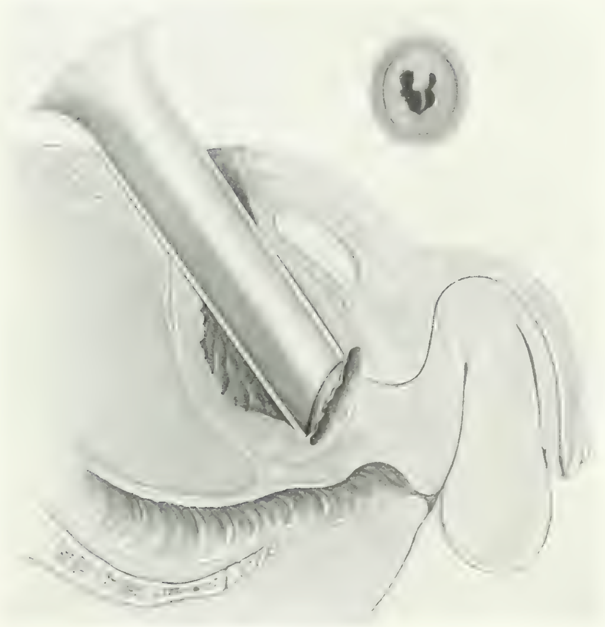
As the growth is turned out into the bladder, the bladder mucous membrane will be stripped up from the posterior side of it, as may be seen in Fig. 38. The point which is most difficult to free is the attachment at the junction of the prostatic and membranous urethra, which is seemingly a fibrous attachment, or may be the attachment to the atrophied posterior lobe which lies distal to the ejaculatory ducts and which prob-

Fig. 38.



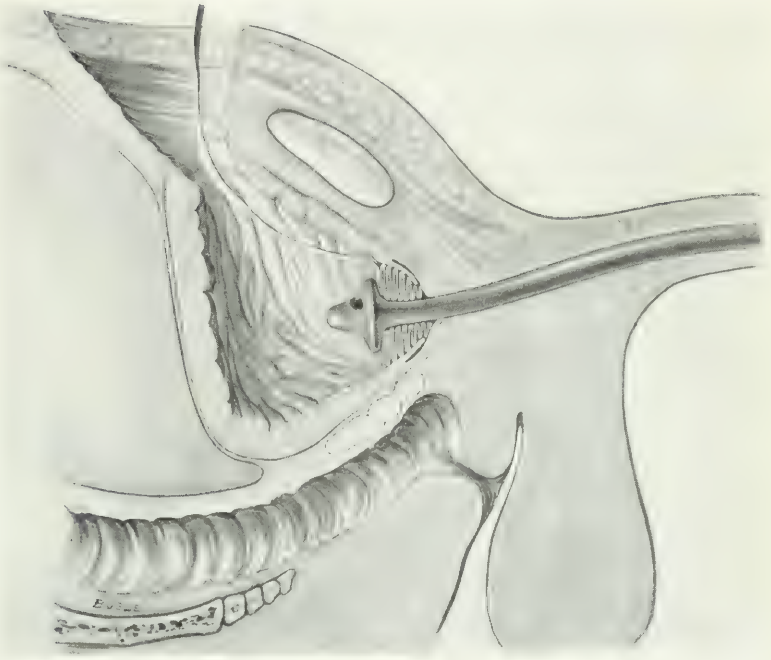
Under surface of prostatic mass showing the enormous median lobe and the small right lobe. "*A*" shows the torn edges of the mucous membrane stripped up from posterior surface.

Fig. 40.



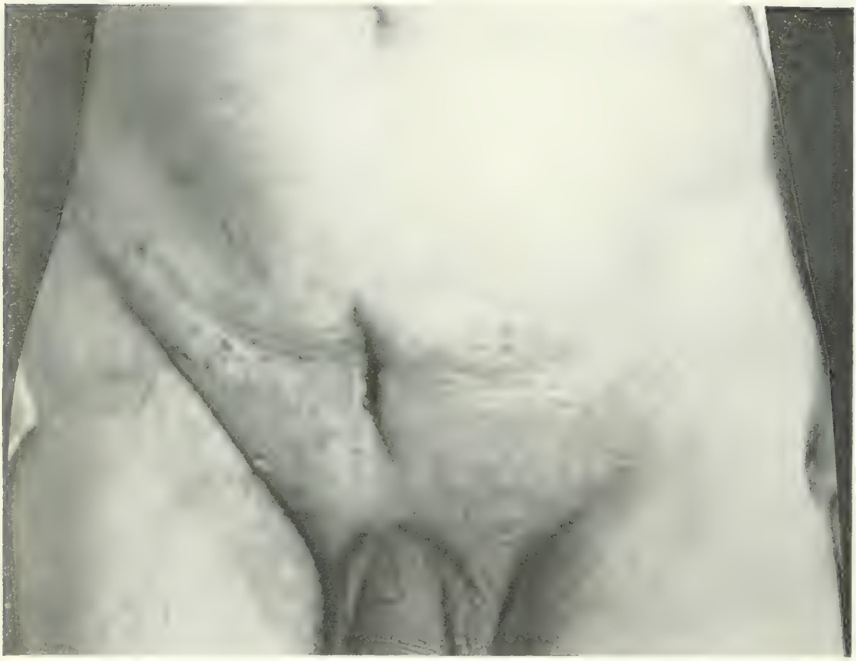
Illustrating the method used by Fenwick to control hemorrhage after prostate had been removed. Small picture in upper right hand corner shows condition frequently found for a small blood-vessel which seemed to be bleeding, contained in the torn edges of the bladder mucous membrane. Illustration shows the speculum in place with the neck of the bladder exposed, that the operator may directly clamp any bleeding vessel. This method in the hands of Fenwick is ideal.

FIG. 41.



Showing method of controlling hemorrhage by the use of packing. The Pezzer catheter is introduced by first passing a silver catheter through the urethra and out through the suprapubic wound attaching the Pezzer catheter to the silver catheter and withdrawing same through the urethra. When the Pezzer catheter is in place, the packing is inserted, consisting of narrow gauze, introducing it in such a way that the torn mucous membrane flaps of the bladder are pushed ahead of the packing and when the packing is in place the Pezzer catheter is pulled down, keeping the packing in place and exerting pressure against the bleeding surface at the same time. In order to hold the Pezzer catheter firmly in place, it should be attached to the leg by adhesive plaster. The gauze is removed after 24 hours and the catheter at will.

FIG. 42.



Appearance of suprapubis at two weeks after the operation. It is meant especially to show the clean appearance of the wound which is entirely free of incrustations or sloughs.

ably is not removed in the majority of cases. It has been our experience that *those cases in which the prostate does not shell out easily should be carefully examined for evidences of malignancy.*

The other type of prostate which is occasionally met with is the enormous prostate which seems to be hypertrophied in all its parts with the exception of the median lobe. Such a prostate is seen in Fig. 12. In removing this prostate it may often be more completely and more easily done by passing the finger between the sphincter vesicæ and the growth itself and sweeping the finger around the growth, as recommended by Freyer. It will quickly fall out into the bladder. This method of enucleation is illustrated in Fig. 39. However, in the majority of cases the intra-urethral enucleation is to be preferred. It is quite essential for the welfare of the patient that all of the prostate as far as possible shall be removed. Thus, Fig. 6 shows a prostate with a very large median lobe and two moderately enlarged lateral lobes, with many pieces of prostatic tissue which were dug out from the capsule after the main growth had been removed. The operator should never be satisfied with removing the larger adenomatous mass alone, but an attempt should be made to bring away all the prostatic tissue possible unless there is a diffuse carcinomatous involvement. If fragments remain, they retard the healing of the cavity from which the prostate has been removed and are apt to necrose and cause a delay in the healing of the bladder.

Third step: Removing the prostatic sections and the blood clots from the bladder. A pair of forceps is passed through the suprapubic wound and the pieces of prostate which have been turned out from the bladder are carefully removed. All of the blood clots in the bladder should be washed out so that no pieces of foreign material are left behind.

Control of the Hemorrhage.—A number of methods have been devised for controlling the hemorrhage.

First, the Fenwick method by clamp and ligature. Fenwick has devised a series of three specula of different sizes which may be introduced through the suprapubic wound, bringing the area from which the prostate has been removed directly into view. The use of one of these speculum is illustrated in Fig. 40. The headlight is used to illuminate the cavity. With the lacerated oozing area in view and properly illuminated, the area is sponged as dry as possible and it will be found, as a rule, that *bleeding does not come so much from the cavity from which the prostate has been removed, but usually from the free edges of the lacerated tissue* which covers the surface of the prostate on its vesical aspect. This was very beautifully demonstrated to the writer by Mr. Fenwick himself. In one case he was able to show me a spurting vessel in this free edge. He demonstrated further that the area from which the prostate has been removed flattens out very quickly and does not remain as a cavity, but retracts down and, as a rule, does not allow space for the accumulation of blood clots. Through the speculum the bleeding points are caught with specially devised hæmostats. In this way, as a rule, the bleeding can be entirely controlled. In most cases after a few minutes crushing with the hæmostats they may be removed and no further bleeding will occur. The hæmostats are so constructed that the handles may be removed, if necessary, and left *in situ* for 24 hours.

As a modification of this method, the writer would suggest the use of the actual cautery through the speculum to control any bleeding point which might come into view.

Second, control by suture. A number of prominent operators complete their prostatectomies by surrounding the area from which the prostate has been removed by a continuous catgut suture. This necessitates a large suprapubic wound and consumes considerable time and, in the experience of the writer, has never been found necessary.

Third, control by pressure. With one finger in the rectum and a finger in the bladder the tissues involved in the prostatic wound may be pressed together and in this way much oozing will be prevented. At the last meeting of the American Urological Society in Boston, April, 1913, the writer presented a method of controlling hemorrhage, using gauze packing.[4]

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[4] Pilcher: *Transactions of the American Urol. Soc.*, 1913, vol. vii, p. 57.

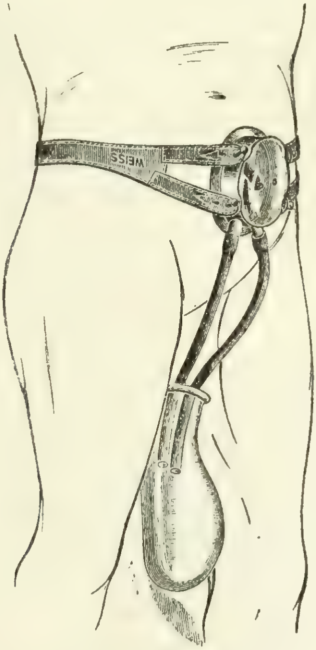
This consists of introducing a catheter through the urethra which serves as a guide and centre around which the packing is to be placed. Then a narrow strip of gauze packing is introduced through the suprapubic wound and the torn edges of mucous membrane which have been stripped up from the prostate are pressed down into the shallow prostatic pouch and held in place by gauze packing, as is shown in Figure 41. This shows the prostatic pouch exaggerated with the torn flaps of mucous membrane pushed before the gauze packing and in addition the Pezzer catheter used to hold the gauze packing in place. This Pezzer catheter may be introduced by first passing a silver catheter through the urethra and out from the suprapubic wound and then attaching the small end of the Pezzer catheter to the silver catheter and drawing it out through the urethra. With the expanded end of the catheter on the vesical side of the packing, considerable pressure may be brought to bear, using a very small amount of gauze packing by pulling on the penile end of the catheter. Up to the present time we have always used the simple rubber catheter as a guide and centre around which to pack the gauze. The end of the gauze is led out through the abdominal wound (Fig. 41). Other methods of controlling hemorrhage by direct pressure have been devised, but none of them are superior to those which have been mentioned.

Control of Secondary Hemorrhage from the Bladder.—Hemorrhages occurring within 12 to 24 hours after the prostatectomy are best controlled by packing the prostatic pouch around a catheter introduced through the urethra. In one case the writer passed a silk suture through the perineum, placed a gauze packing over the prostatic pouch and fastened the silk suture to this gauze packing, tying the same on the outside of the perineum. *Secondary hemorrhage which occurs a week or so after the operation* may be either from the wound itself which calls for re-opening the wound and suture, or may be from the vesical neck or the prostatic pouch itself. Such an occurrence calls for re-opening of the bladder, exposure of the bleeding point and securing same either by suture, the actual cautery or the high-frequency spark generated from the D'Arsonval current. In one case of my own, it was necessary after the second week to re-open the bladder widely and cauterize the entire area of the vesical neck before the hemorrhage could be stopped.

Drainage of the Bladder After Transvesical Prostatectomy.—To the mind of the writer, it is very *essential to drain the bladder suprapubically after every case of prostatectomy.* We consider it dangerous and unnecessary to run the risk of closing the bladder after transvesical prostatectomy. This has been emphasized in our own experience in two cases in which we closed the bladder and were compelled to re-open and drain the bladder on account of severe hemorrhage within the bladder which clogged the urethral catheter. Our routine is, as soon as the prostate is removed and the hemorrhage checked, to introduce a large rubber drainage tube, one inch in diameter, just within the wall of the bladder, and after securing it in place to apply copious gauze dressings over the same. If the packing of the prostatic pouch is necessary, a small gauze packing is brought out through the large drainage tube. It should be emphasized at this point that none of the silk skin sutures introduced at the primary operation have been removed, and that after the enucleation of the prostate no suturing of the wound is necessary. The cystostomy wound made at the first operation is capable of very great distention without tearing it open if the original sutures have not been removed.

After-treatment.—As soon as the patient has been returned to his bed a proctoclysis of tap water is begun and the abdominal dressings changed as frequently as necessary. *After 24 hours* the bladder is irrigated through the suprapubic tube which is still in place. If packing is in place it is removed, together with the large suprapubic drainage tube. The Pezzer catheter replaces the suprapubic drainage tube. It will be found that in six to eight hours the bladder wall will contract around the Pezzer catheter and very little urine will leak out beside it. The Pezzer catheter is left in place for three or four days until the wound surfaces have healed over. This tends to prevent the formation of sloughs and phosphatic concretions on the wound surfaces (Fig. 42). Also, the use of drugs to prevent alkalinity of the urine will tend to give a better wound. *On the fourth or fifth day* the Pezzer catheter is removed and is replaced by a collecting device of an English maker, which is shown in Fig. 43. The wound is strapped with a piece of inch-wide adhesive tape and what urine escapes is collected in the celluloid cup and drains from the cup into a bottle through a rubber tube. This ingenious device is held in place by rubber straps which keep it from slipping. It is a very convenient and comfortable adjunct to the convalescence. If the suprapubic cup is not available, the use merely of masses of absorbent gauze over the fistula will answer any need until the fistula closes and normal urethral urination is re-established.

FIG. 43.



The period of healing of the suprapubic wound has in our experience taken from one week to four weeks, *the average be-*

ing about 16 days. In none of our cases has there been any permanent suprapubic fistula. The nearest approach to it was in the case of recurrent secondary hemorrhage in which the bladder was twice widely opened in order to control the hemorrhage. In one case the suprapubic wound closed in four days.

Control of the Urine.—About the eighth to tenth day, as a rule, small amounts of urine will pass *per urethram,* the amount increasing as the suprapubic wound contracts. It is worthy of note that in none of our recent cases has dribbling been noticed, and that within two or three weeks after the operation the patients have fairly good control, and in all the cases operated upon by us after this method the result has been full control of the urine with complete emptying of the bladder.

Potency of the Male.—This operation does not seem to interfere with the functions of the ejaculatory ducts, in fact, in a number of instances the potency has increased as a result of the operation.

CONCLUSIONS.

Studies of the living pathology of chronic prostatism lead us to the conclusion that obstructive prostatic hypertrophy usually involves the two lateral lobes and the median lobe, and that inasmuch as the obstruction is at the neck of the bladder and the obstructing body projects into the bladder, the natural avenue of approach is the transvesical route.

Second, as a result of relieving the distention of the bladder, three phases of kidney secretion are demonstrable; the second phase, lasting from a few days to a number of weeks, constitutes a period of danger during which no surgical attack should be undertaken.

Third, the technic advocated in the present paper includes a two-step transvesical operation in every instance for the relief of benign hypertrophy of the prostate. Preliminary cystostomy is preferred for the reason that, following the suprapubic cystostomy the patient is out of bed in 24 hours; the urinary output from the bladder is completely controlled; there is no unpleasantness or traumatism due to the passage of the catheter through the urethra, and the operation of transvesical prostatectomy is already half completed.

Fourth, since applying these principles we are able to report to date 28 successive successful cases, every case resulting in the control of urine by the patient and his ability to empty the bladder without using a catheter. In some cases of enormous distention of the bladder, it is necessary to catheterize for a certain length of time before employing suprapubic cystostomy on account of the extreme back pressure on the kidneys, the sudden decompression of which might result fatally.

Fifth, these same rules do not apply in cases where carcinoma of the prostate has been diagnosed, or even where its presence is fairly well suspected. A later communication will deal with this part of the subject.

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THE NORMAL BLADDER AND ITS SPHINCTERS AND THE CHANGES FOLLOWING SUPRAPUBIC PROSTATECTOMY.*

A STUDY BASED ON RADIOGRAPHIC FINDINGS.

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INCONTINENCE of urine following prostatectomy is encountered infrequently, and very rarely after suprapubic enucleation; it is more often met with after the perineal operation. The cause of this condition has not been definitely determined. The object of this study is to inquire into the mechanism of urination following suprapubic prostatectomy and to note the changes in the topography of the bladder resulting from this operation. It was believed that by such an investigation additional light would be cast upon the question of postoperative incontinence of urine.

As a preliminary it was deemed advisable to make a number of observations of the normal bladder, and of the condition of the bladder in prostatic enlargement, in order the better to correlate the findings.

THE NORMAL BLADDER.

A résumé of the literature dealing with the mechanism of the sphincters of the normal bladder shows that considerable discrepancy of opinion still exists concerning the rôles played by the internal vesical sphincter and the external sphincter, or compressor urethræ muscle.

A brief description of the anatomy of the bladder and its sphincters may aid in understanding some features to which I shall subsequently refer. Although individual opinions vary, it appears to me that Leedham-Greene [1] presents the best summary of the standard anatomists, and I will therefore quote from his description:

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* Read before the American Urological Association, New York Society, December, 1913.

" Anatomists while differing considerably in minor details, describe three more or less distinct constrictor muscles in connection with the bladder and urethra, though their opinions differ greatly as to the part these muscles play in maintaining the closure of the bladder. They are as follows:

" *A.* A slender ill-defined ring of oblique muscular fibres intermingled with elastic tissue, encircles the vesical opening, and is formed of unstriped or involuntary muscular tissue. According as to whether it is regarded as belonging to the bladder proper or to the prostate, it is called the internal vesical ' or internal prostatic ' sphincter.

" *B.* Below the internal sphincter some short transverse muscular fibres are present on the anterior or ventral surface of the lower or distal half of the prostate. They rapidly increase in length as they approach the apex of the prostate until they completely encircle the urethra. The majority of these fibres, chiefly composed of voluntary muscular tissue, are situated on the outer surface of the prostate. All these fibres together comprise the external prostatic or vesical sphincter of Henle, which according to Griffiths [2] is merely the commencement of the constrictor urethræ.

" And lastly, surrounding the membranous urethra, contiguous to the anterior portion of the external prostatic sphincter is that muscle, or group of muscles, best known as the compressor urethræ."

It is well recognized, that but two of these muscles are of importance in the act of micturition, the smooth muscle, involuntary internal vesical sphincter, and the striated voluntary compressor urethræ.

Concerning the topography of the normal bladder the following may be said. The most fixed portion of the bladder is the outlet, being firmly held by its attachments to the prostate and urogenital musculature. The position of the sphincter, of course, varies according to the skeletal development, the musculature, the age of the patient and the condition of the neighboring organs; for it can readily be seen that tumors, congenital defects, prostatic enlargement, and other pathological conditions influence its location. According to Langer,[3] the internal urethral orifice in a normal, slightly-filled bladder is between 2.2 and 4.5 centimetres from the posterior aspect of the symphysis. As the bladder distends the orifice is pushed downward. Richet locates the internal sphincter on a line from the under border of the symphysis to the fourth sacral vertebra; while Kohlrausch[4] places it on a line from the upper border of the symphysis to the tip of the coccyx. All these observations were made upon the cadaver.

The contour of the normal bladder has long been the subject of much discussion. Most of the work in this connection has been carried out upon the cadaver by means of different methods. The bladder has been filled both from the urethra and from the ureters with wax, plaster of Paris, formalin and other solutions; it has been inflated with air, and has also been studied by means of frozen sections. As a result of these investigations the bladder has been variously described as being cylindrical, ovoid, elliptical or spheroid. It is evident, however, that the bladder is not equally distensible, for if it were so, its shape when filled would be round. Furthermore, Langer has carefully demonstrated that the region of the outlet is the least distensible, especially so at the trigone. His observations are borne out by the fact that in the markedly distended bladder there is but slight variation in the distance between the two ureters.

In 1905 a new method of studying the form of the bladder was devised by Völcker and Lichtenberg.[5] They employed collargol injections combined with radiography, and as a result of their work concluded that the normal bladder when distended is invariably broader above than below, and is never round. Subsequently Leedham-Greene, using the same technic, reported that the radiographs he obtained showed the bladder to be oval in shape. His photographs, however, demonstrate a bladder round in form. More recently two articles have appeared dealing with this subject; in the first, by Barringer and MacKee,[6] the results obtained coincided with those of Völcker and Lichtenberg; in the second, by Uhle and MacKinney,[7] the radiographs more closely resembled the round form of Leedham-Greene.

Turning now to the action of the sphincters when the bladder is fully distended, a study of the literature again discloses considerable difference of opinion; all authors, however, are agreed that in the moderately distended bladder it is the internal vesical sphincter that is active in retaining the urine. This diversity of opinion is due in part to the different methods employed. The earlier investigators worked on the cadaver. Thus Born,[8] using ureteral injections of plaster of Paris, found that the closure took place at the internal vesical sphincter. From a series of anatomical studies Kohlrausch believed that folds of mucous membrane which he found near the internal urethral orifice acted as the sphincter. Barkow [9] termed the internal urethral orifice, the annulus elasticus, and considered that the sphincter. Henle,[10] however, showed that the action of this sphincter was not due to elastic fibres, but to smooth muscle, so that this constituted a true sphincter. Later anatomists and clinicians making their studies on animals and the living human being placed the seat of vesical closure at the external sphincter, the compressor urethræ muscle. Guyon,[11] Ultzman,[12] Finger [13] and many others were of the opinion that in the distended bladder the internal sphincter was not of sufficient strength to retain the urine. They believe that when the bladder is distended the posterior urethra becomes part of it, forming a funnel-shaped outlet, with the closure taking place at the compressor urethræ muscle. These authors base their arguments in part upon the fact that in the fully distended bladder the urethra is from one and one-half to two centimetres shorter than when the bladder is but moderately filled. v. Zeissel,[14] however, believes that this shortening is not sufficient to justify placing the closure at the compressor urthræ, for if this were so there should be at least four centimetres shortening; that is, the length of the prostatic urethra. More recent writers (Ruggles,[15] Wilson and McGrath [16]) basing their opinions on the older methods of study continue to adhere to the belief that the compressor urethræ muscle is of paramount importance in retaining the urine in the fully distended bladder. Thus to quote one of these authors, Ruggles, " We all know, or ought at least, that the vesical sphincter is a comparatively weak muscle and that the only muscles by the action of which we are enabled to resist a strong desire to urinate is the external sphincter or compressor urethræ, which is a strong voluntary muscle."

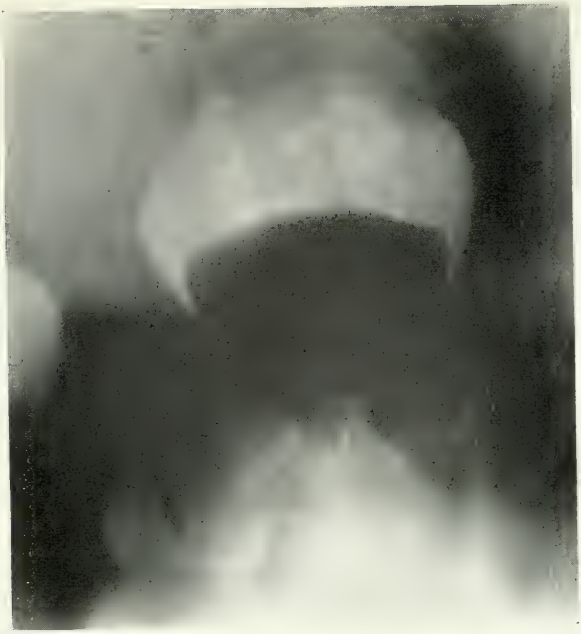
The method of Völcker and Lichtenberg—collargol injections combined with radiography—offered the best physiological method of studying this much discussed question, and conclusions reached by its application appear to me to definitely solve this problem. As previously stated, Völcker and Lichtenberg showed that the bladder is broader above, narrowing down at the outlet; they also demonstrated in their collargol radiographs that the internal vesical sphincter is the sphincter that prevents the escape of fluid from the fully distended bladder; and they never observed a funnel-shaped formation. Later investigators (Leedham-Greene, Barringer and MacKee, Uhle and MacKinney) using a similar technic substantiated their findings. Oppenheim and Loew [17] are the only observers who maintain that the closure takes place at the compressor urethræ. Their work, however, was done on monkeys, using bismuth injections; furthermore, their radiographs were rather indistinct in outline and by no means conclusive.

Before proceeding with the details of the work, I wish briefly to state that my observations on the normal bladder are in the main in concordance with the work of Völcker and Lichtenberg.

TECHNIC AND RESULTS OF RADIOGRAPHIC EXAMINATIONS OF THE NORMAL BLADDER.

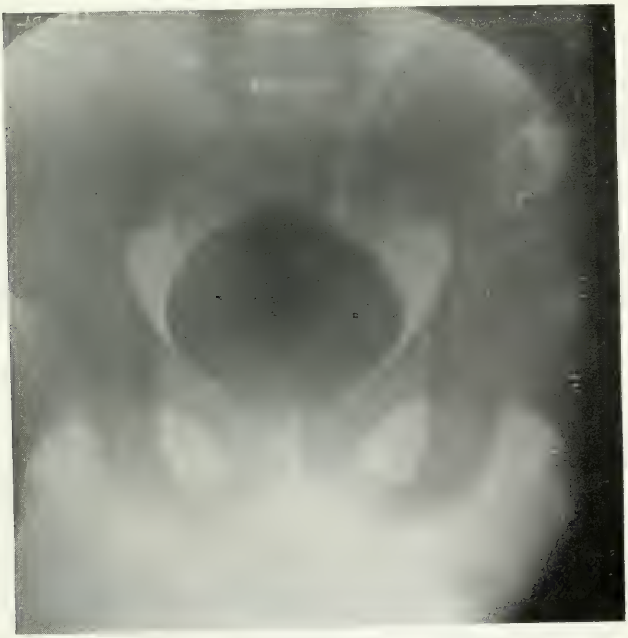
These radiographic studies were begun two years ago. In the beginning three different positions were tried, the ventrodorsal (patient lying flat on back), the dorsoventral (patient on

Fig. 1.



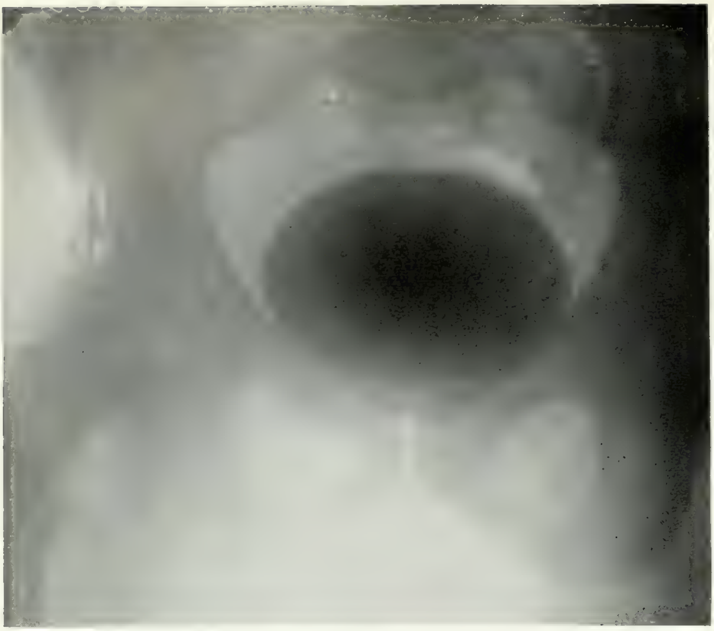
Normal bladder distended with 180 c.c. of collargol, showing broad upper portion, narrowing at outlet.

Fig. 2.



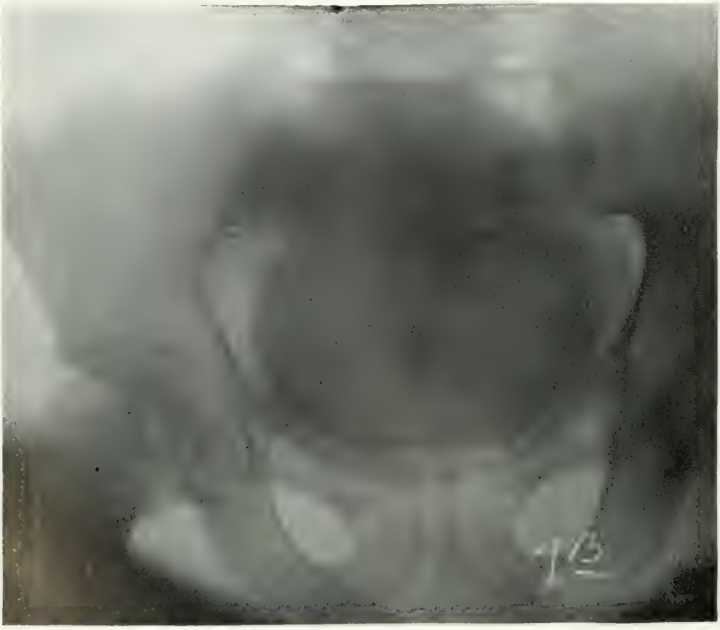
Normal bladder distended with 225 c.c. of collargol.

Fig. 3.



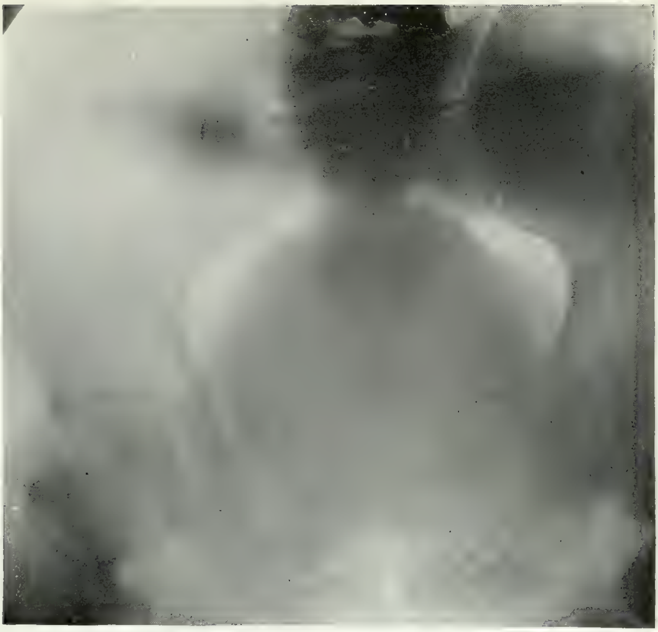
Normal bladder of same patient as Fig. 2 taken in dorsoventral position; showing but slight variation from preceding one.

Fig. 4.



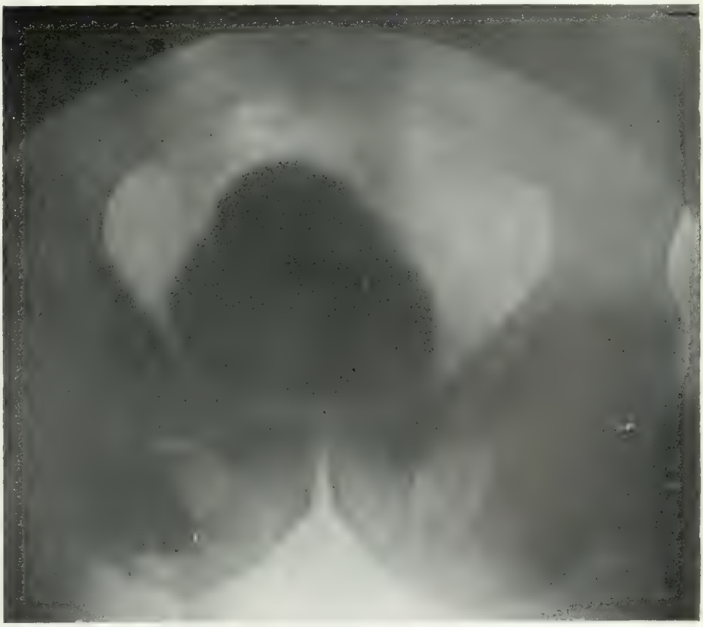
Normal bladder distended with 420 c.c. of collargol. Approaches round type of bladder. Urethra sharply demarcated.

Fig. 5.



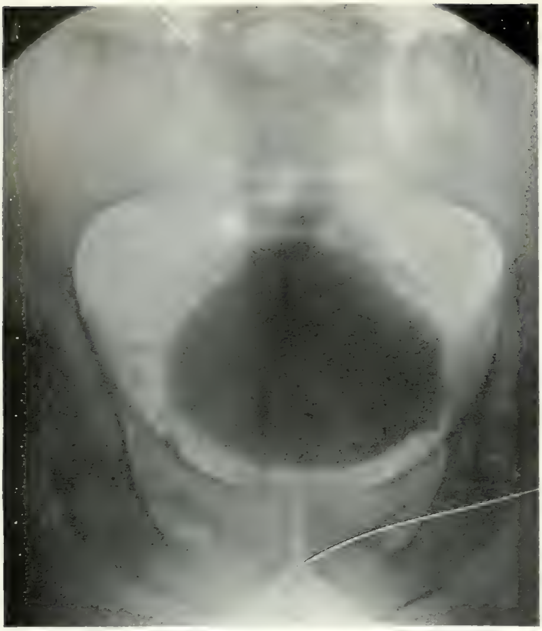
Normal bladder, same patient as Fig. 4 taken with tube in oblique position, and showing how outlet is cut off by this method.

Fig. 6.



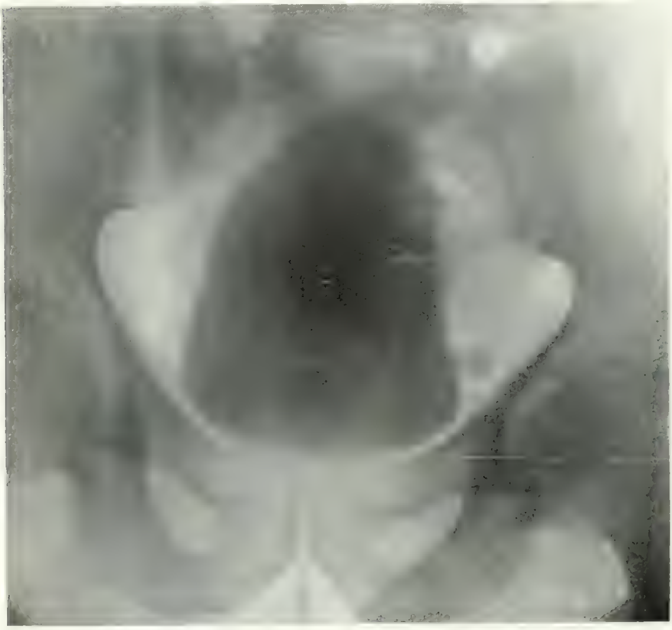
Bladder in prostatic hypertrophy; distended with 150 c.c. collargol; showing high location above symphysis with flattening of the base.

Fig. 7.



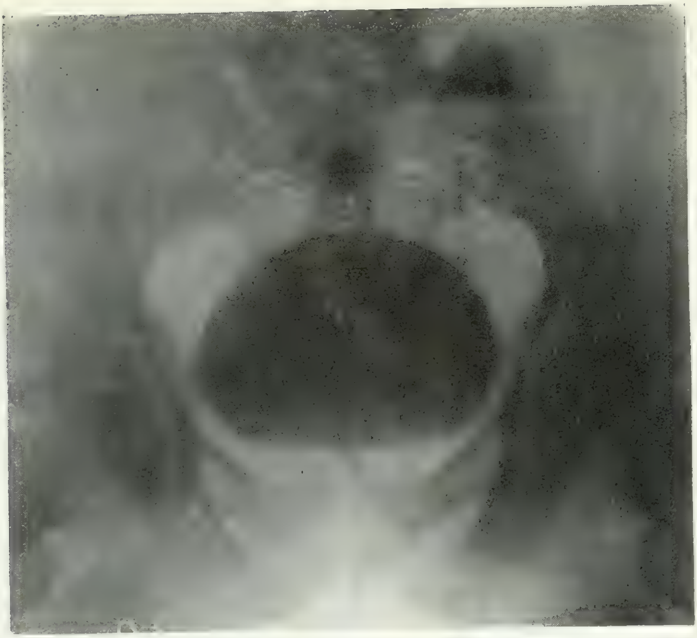
Bladder in prostatic hypertrophy; distended with 200 c.c. collargol. Numerous irregular shaped diverticulæ present.

Fig. 8.



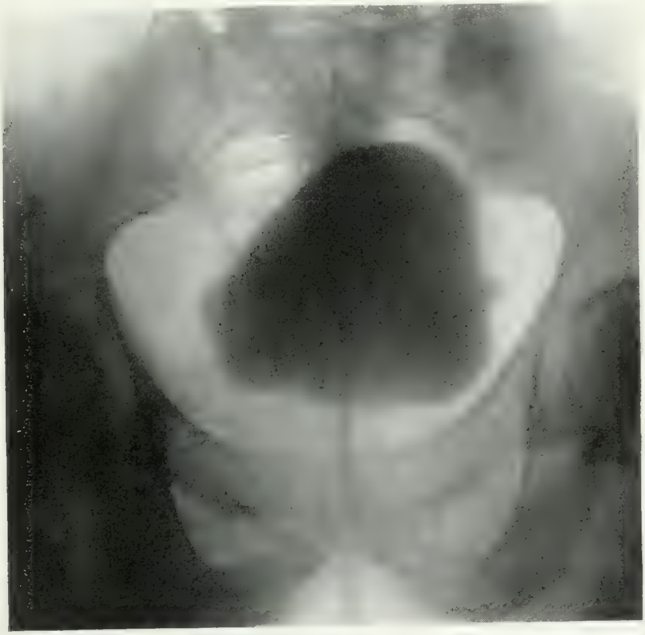
Bladder in prostatic hypertrophy; distended with 240 c.c. collargol; showing peculiar [illegible] shape.

Fig. 9.



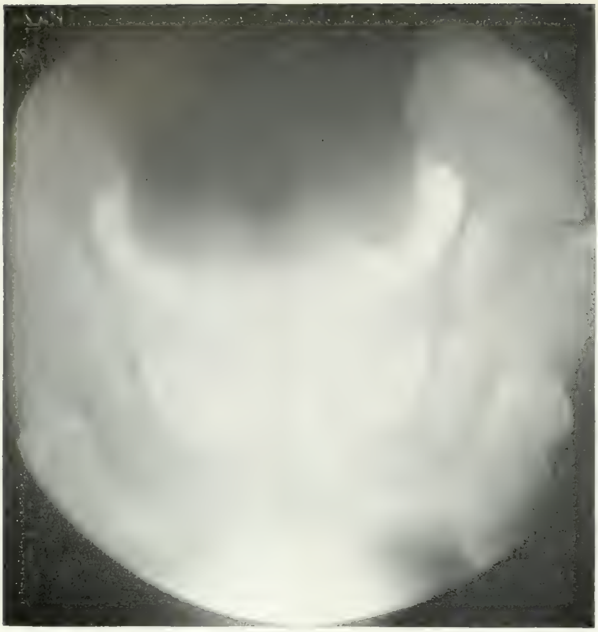
Bladder in prostatic hypertrophy; distended with 240 c.c. collargol; showing high location above symphysis, broad, flat base, with urethra sharply demarcated.

Fig. 10.



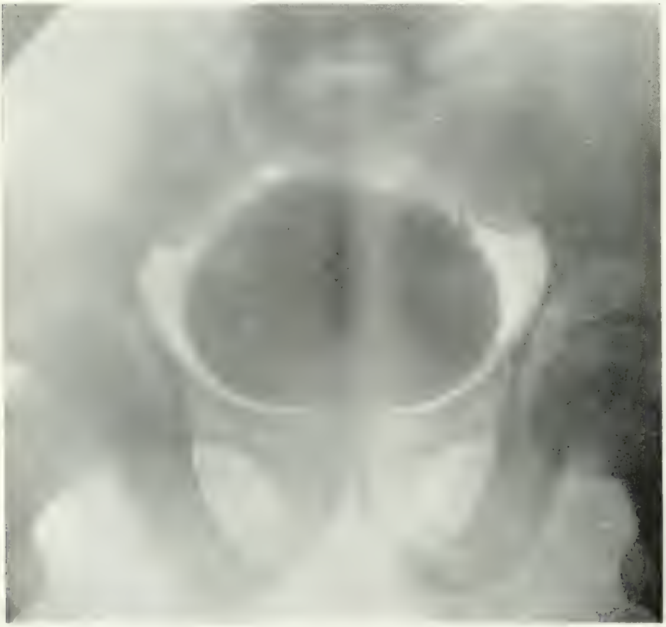
Bladder in prostatic hypertrophy; distended with 180 c.c. collargol; showing irregular shape, high location above symphysis, and two diverticulæ.

FIG. 11.



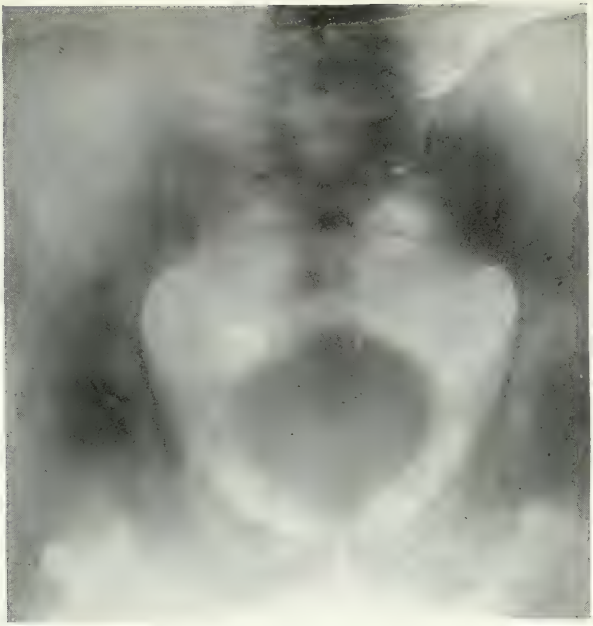
Bladder in prostatic hypertrophy, distended with 300 c.c. of collargol, showing bulging and irregularity of base.

FIG. 12.



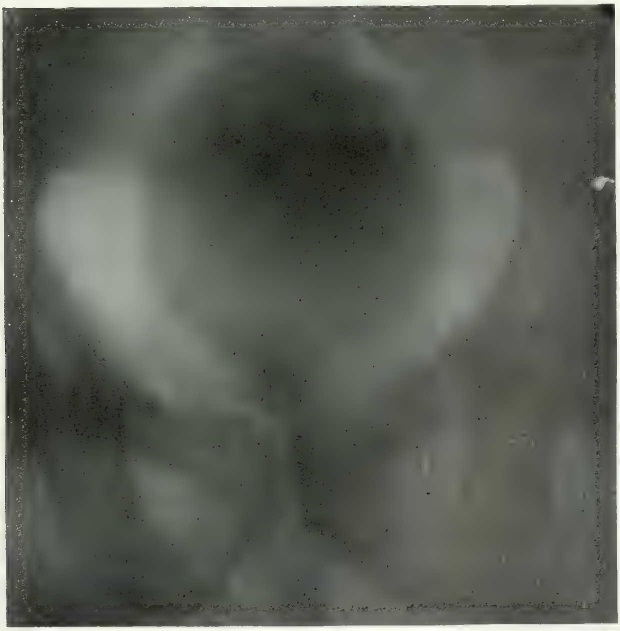
Bladder following suprapubic prostatectomy, 10 months after operation, showing a small funnel-shaped formation.

Fig. 13.



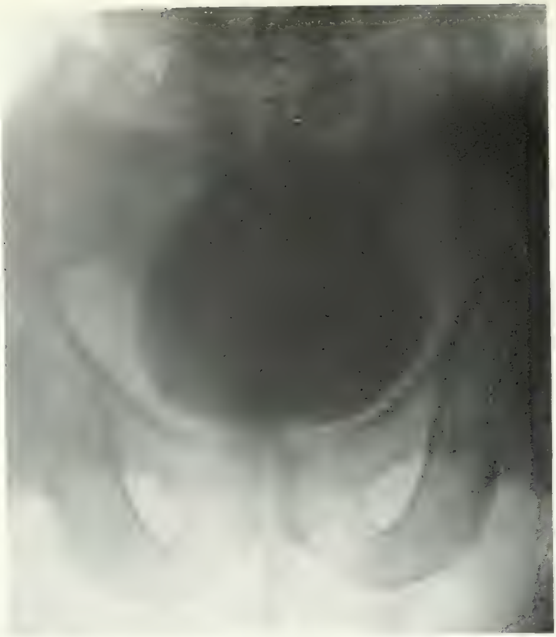
Bladder following suprapubic prostatectomy; 9 months after operation; showing funnel-shaped cavity continuous with bladder.

Fig. 14.



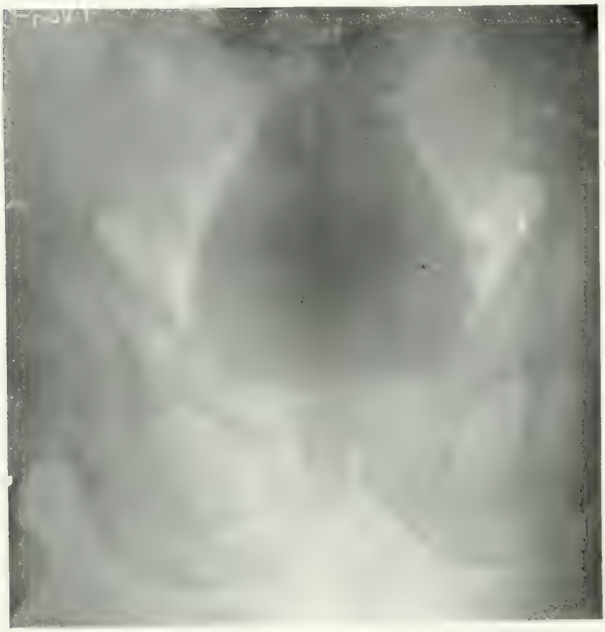
Bladder following suprapubic prostatectomy, 6 months after operation; showing collection of collargol in pouch formerly occupied by prostate.

Fig. 15.



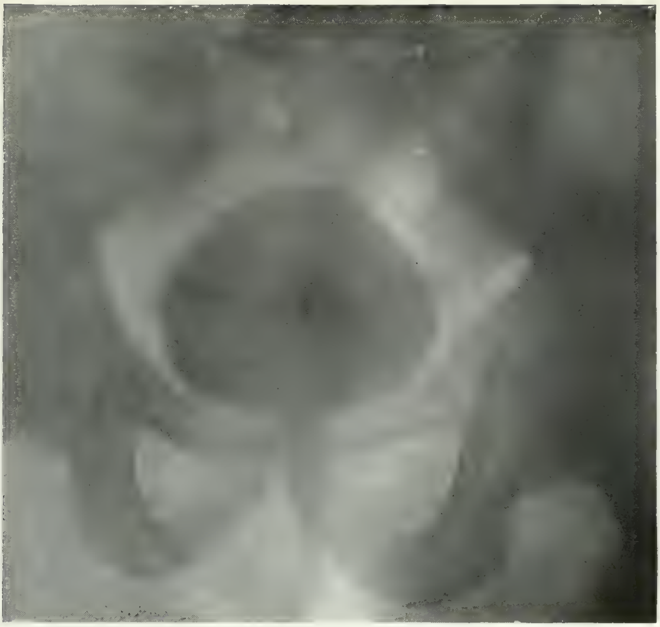
Bladder following suprapubic prostatectomy, 1½ years after operation; showing collection of collargol in cavity below and continuous with the bladder.

Fig. 16.



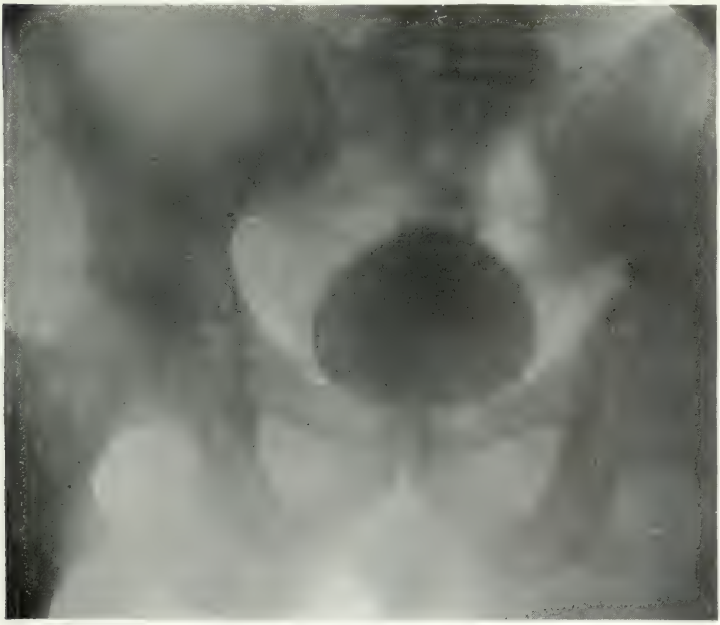
Bladder following suprapubic prostatectomy, 1½ years after operation; showing collargol in cavity below and continuous with the bladder.

Fig. 17.



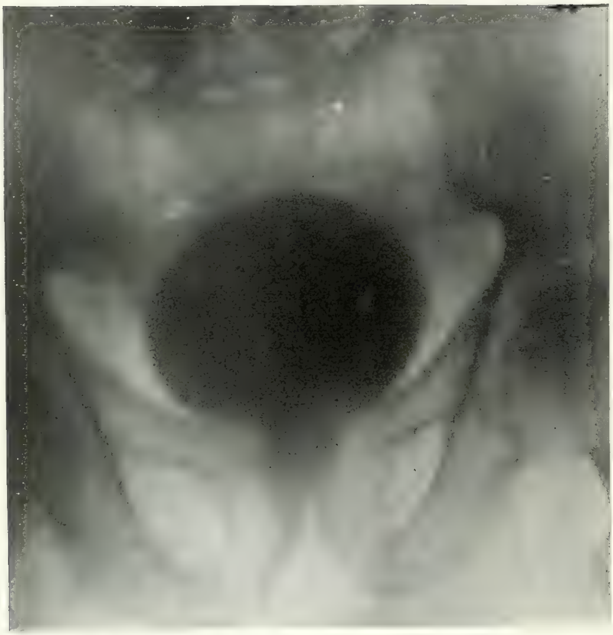
Bladder following suprapubic prostatectomy, 1½ years after operation; showing similar condition.

Fig. 18.



Bladder following suprapubic prostatectomy; same patient as Fig. 17 with bladder, however, containing half the amount of solution, and showing similar formation.

FIG. 19.



Bladder following suprapubic prostatectomy, 5 years after operation; showing large collection of collargol in cavity below and continuous with the bladder.

abdomen), and the lateral. The lateral views were very unsatisfactory owing to the density of the muscular and bony structures of the pelvis. The dorsoventral and ventrodorsal gave practically the same results, and the latter, the ventrodorsal position, because more convenient was adopted as a routine. The position of the X-ray tube is of considerable importance. The earlier radiographs were taken with the tube placed posterior and obliquely to a vertical plane passing through the symphysis pubis. It was found, however, that this position failed to give a good view of the outlet of the bladder. Subsequently, therefore, the tube was placed so that its focus was at a right angle to the plate, the rays striking the body just above the symphysis. A compression blend was used; but moderate compression was applied, however, so as not to distort the bladder. The medium used was a 5 per cent. solution of collargol which in the large majority of cases was found to be non-irritating. The solution was introduced through a catheter which was then withdrawn.

Twelve radiographic exposures of normal bladders were made and as the main object was the study of the sphincteric region, the bladders were fully distended.

The shape of the normal bladder was found to be variable, although the type most frequently encountered was that showing a broad upper portion, narrowing down toward the outlet. A few of the pictures closely approached the round type described by Leedham-Greene, while twice the bladder assumed an ovoid shape with the long diameter extending from the fundus to the base. Legueu [18] has recently described a reverse type, the bladder broad below, and narrow above, as characteristic of the normal bladder with the patient in the prone position. This type was not observed in any of the cases in my series. In the radiographs the urethra was invariably found to be sharply demarcated from the bladder, thus demonstrating that the internal vesical sphincter is the muscle that retains fluid in the distended bladder. The position of the internal sphincter was either on a level with the upper border of the symphysis pubis, or midway between the upper and lower borders.

THE BLADDER IN PROSTATIC HYPERTROPHY.

Before beginning a study of the condition of the bladder following prostatectomy, it was considered desirable to take a series of radiographs on unoperated cases of enlarged prostate, in order to better determine the changes following the operation. Marked changes in the contour of the bladder were observed in these unoperated cases. They varied from the small contracted bladder to the larger, irregular, flaccid type. Vesical diverticulæ, so frequently encountered in prostatic enlargement, were distinctly shown in several instances. Changes characteristic of prostatic enlargement are to be found at the base of the bladder. Instead of a broad upper part narrowing at the outlet, the opposite picture was seen. The inferior portion of the bladder was broad and flat or sinuous; at times an upward bulging, due to the gland projecting into the bladder, was observed. This flattening of the inferior portion of the bladder may be said to be characteristic of prostatic enlargement. The bladder was situated on a higher plane than in the normal, the level depending upon the size of the gland. Its base was found to be opposite the upper border of the symphysis, or more often one to two centimetres higher. The prostatic lobes could not be definitely demonstrated radiographically.

The question of sphincteric control in prostatic enlargement seems to me to be decisively settled by the radiographs. Wallace,[19] in a recent publication, writes, " When a prostate enlarges the adenomatous mass sometimes makes its way through and distends the sphincter to such a degree as to render it probably useless. The question of whether the bladder is controlled by the internal or external sphincter remains unsolved. " My radiographs show conclusively, however, that even in the most extreme distention of the bladder the internal vesical sphincter is the seat of closure. When the marked changes in the sphincteric region with the resultant distortion are considered, it is really remarkable that the muscle retains so much of its functional activity.

THE CONDITION OF THE BLADDER FOLLOWING SUPRAPUBIC PROSTATECTOMY.

The mechanism of sphincteric control after prostatectomy is still imperfectly understood. Very few references to this subject are to be found in the literature, and the opinions expressed are not in accordance. Thus Hagner and Fuller [20] in a recent publication state, " that the cause of the loss of control after prostatectomy is a debatable question. It is unquestionably due to the destruction of the muscle at the neck of the bladder, in the prostatic urethra, or in the membranous urethra." Squier [21] is of the opinion that the internal sphincter remains intact and soon contracts to its normal calibre. Other authors, however, have placed the seat of bladder closure following operation at the compressor urethræ muscle. Thus Freyer,[22] reporting an autopsy upon a patient who died twenty-two days after operation, found the bladder pear- or funnel-shaped, instead of globular, the inner surface of the urethra terminating at the triangular ligament. In a personal communication, Lilienthal states that he believes that the compressor urethræ forms the true sphincter of the bladder after prostatectomy.

As far as can be ascertained from a review of the literature but few attempts have been made to study the bladder after prostatectomy by means of radiography. Wallace,[23] using a bismuth suspension, reported one case in which a skiagraph of the bladder was taken. His description is as follows: " The skiagraph shows the bladder cavity continuous with the cavity from which the prostatic adenomata were removed. As the prostate had a distinct intravesical projection the internal sphincter must have stretched considerably. Its situation is presumably at or just distal to the ledge or shelf forming the separation between the two cavities. If this presumption is right, the internal sphincter could not have had any effect in controlling the urine and it must be supposed that a man can have normal micturition without an efficient internal vesical sphincter." Another case, reported by Legueu, confirms Wallace's findings.

Thirty-eight patients upon whom suprapubic prostatectomy had been performed were selected for this study, and in all some seventy-five radiographs were taken. The technic employed was that previously described for the normal bladder. The radiographs were taken at various intervals following operation, ranging from two months to three years. A few of the patients were radiographed several times at successive periods after operation in order to determine if time played a rôle in changing conditions observed. No appreciable differences were noted beyond the fact that an increase in the capacity was evident in the small contracted bladder after appropriate treatment had been instituted.

Concerning the contour of the bladder it was noted that its broad base so characteristic of the unoperated enlarged prostate remained practically unchanged, occasionally, however, the bladder was found on a higher level than in the unoperated case. The vault of the bladder often assumes a pear-shaped form, probably due to adhesions between the bladder and the abdominal wall. The most interesting and important changes are to be found at the outlet of the bladder.

In a small proportion of the cases only a very slight funnel formation in the region of the internal sphincter was observed; in a very few instances no changes at the outlet were to be found. It is therefore evident that in this small group of cases the internal sphincter has not been sufficiently injured by the operation to interfere with its proper function.

In the great majority of the cases (28 in a series of 38 cases) the radiographs showed two distinct cavities, a larger superior one corresponding to the bladder proper, and a smaller inferior one extending from the lower margin of the bladder and continuous with it, to the region of the compressor urethræ. The latter corresponds to the defect left by the removal of the enlarged gland. The contour of this cavity varies from a round or oval to a funnel-shaped formation. The latter is more frequent, the broad base being superior. There can be only one interpretation to these findings—the internal vesical sphincter has either been destroyed by the operation, or its function so impaired that it could not have had any effect in retaining the fluid in the bladder; this has been accomplished by the compressor urethræ muscle. In other words, the true sphincter of the bladder following suprapubic prostatectomy is situated at the membranous portion of the urethra. That this is so, I have been able to further prove by urethroscopic examinations of the posterior urethra; also by demonstrating that in these cases a catheter passed just beyond the compressor muscle completely empties the distended bladder without voluntary effort on the part of the patient. There can be no question that the compressor urethræ muscle acts as an efficient sphincter, for all of the cases in this series have excellent urinary control. That the collection of collargol found in the pouch formerly occupied by the prostate is not an overflow phenomenon caused by vesical distention is demonstrated by radiographs showing the same formation in the bladder but slightly distended. A careful examination of the radiographs reveals the fact that in some cases the two cavities are separated by a narrow isthmus. This would lead one to believe that in these instances the sphincter has either partially regenerated after the operation, or was incompletely destroyed by the operation. That the cavity left by the enucleation of the gland is not obliterated, and that the internal sphincter is not completely regenerated, is shown by the very definite radiographs after an interval of three years.

In conclusion it may be stated that

1. The internal vesical sphincter is the true sphincter of the normal bladder, and of the bladder in prostatic enlargement.

2. The external vesical sphincter, "compressor urethræ," is the functionating sphincter after suprapubic prostatectomy in the large majority of cases.

I desire to thank Dr. Edwin Beer, Attending Surgeon to the Genito-Urinary Service of Mount Sinai Hospital, for having placed his material at my disposal; and Dr. Jaches and Mr. Scholtz, of the X-ray Department, for the excellent röntgenograms.

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[17] Oppenheim and Loew: Der Mechanismus des Blasenverschlusses in Rontgenbild. Centralblatt F. d. K. der Harn and Sexual Organe, 1906.
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[19] Wallace: Prostatic Enlargement, London, 1907.
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[22] Freyer: Surgical Diseases of the Urinary Organs, London, 1908.
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EVERSION OF BLADDER.

AS A LATE SEQUEL OF MUTILATION CAUSED BY RAPE IN EARLY CHILDHOOD.

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In a recent hospital service a young woman twenty-one years old presented herself with the following history:

When a child of fours years she was enticed away by a strange man and raped and left unconscious. She was found some hours later and taken to the nearest physician, who succeeded in checking a slow hemorrhage from a ruptured perineum and bladder. She rallied from the immediate effects of the assault and later was taken to the Memorial Hospital in Worcester where she received surgical attention, including two operations on the bladder. She suffered incontinence of urine from the time of the assault. The operations failed to relieve her. In the subsequent years she had constantly leaked urine but with the aid of a portable urinal she had successfully held her own in school life and had graduated at the High School. She had faced her infirmity with surprising patience and fortitude. What now led her to seek hospital aid was a disquieting and embarrassing physical change at the vulva which had slowly developed making it almost impossible for her to sit up or be about. On examination the condition was found which is exhibited in the accompanying color sketch (Fig. 1). There was complete procidentia uteri with also complete eversion of the bladder. There was no meatus and no trace of a sphincter. The bladder mucous membrane was in a chronic state of inflammatory infiltration, intensely red and granular. The ureteral openings were plainly demonstrable. An X-ray study showed absence of the pubic arch (see Fig. 2).

Analysis of the condition as a whole seemed to warrant the following conclusions. At the time of the assault most violent injury was done to the perineum, the anterior vaginal wall, the bladder, and the pubic arch. The pelvic floor was so mutilated that it no longer furnished support for the uterus, therefore, as the patient developed into womanhood the uterus sank down until it occupied a position entirely outside the body. With the prolapse of the uterus the ruptured bladder had been dragged down and completely everted. This eversion was possibly more extreme and prominent because of loss of the pubic arch. The absence of the pubic arch presented a more difficult problem for solution. On exposure of this condition by the X-ray the question came up as to the possibility of a congenital defect—an exstrophy of the bladder—and an error in the story of assault, rape, etc. All questions on this point were thoroughly banished by the testimony of the physician who attended her immediately after the assault (Dr. R. W. Swan, of Worcester, Mass.) and her own straightforward story of perfectly normal urinary function prior to the assault. It is indeed difficult even at this writing to comprehend such injury to the pubic arch as shown in the skiagraph unless infection, at the time of the assault and subsequent thereto, reached the pubic bones and a destructive osteomyelitis was the real cause of the osseous defect. What could be done surgically to relieve this distressing condition? Obviously the first thought was a plastic operation to cover the bladder defect and afford protection to the exposed mucous membrane, followed by some kind of an operation to remedy the procidentia. Careful consideration of all the attendant conditions seemed to point to the following conclusions:

1. Since there was no urethra, no sphincter vesicæ and no meatus urinarius remaining, any efforts to reconstruct the bladder would only result in the formation of a cloaca, lined with hopelessly diseased and infected mucous membrane which would be, throughout the rest of the patient's life, an unclean pocket and would in no wise serve as a reservoir for the urine.

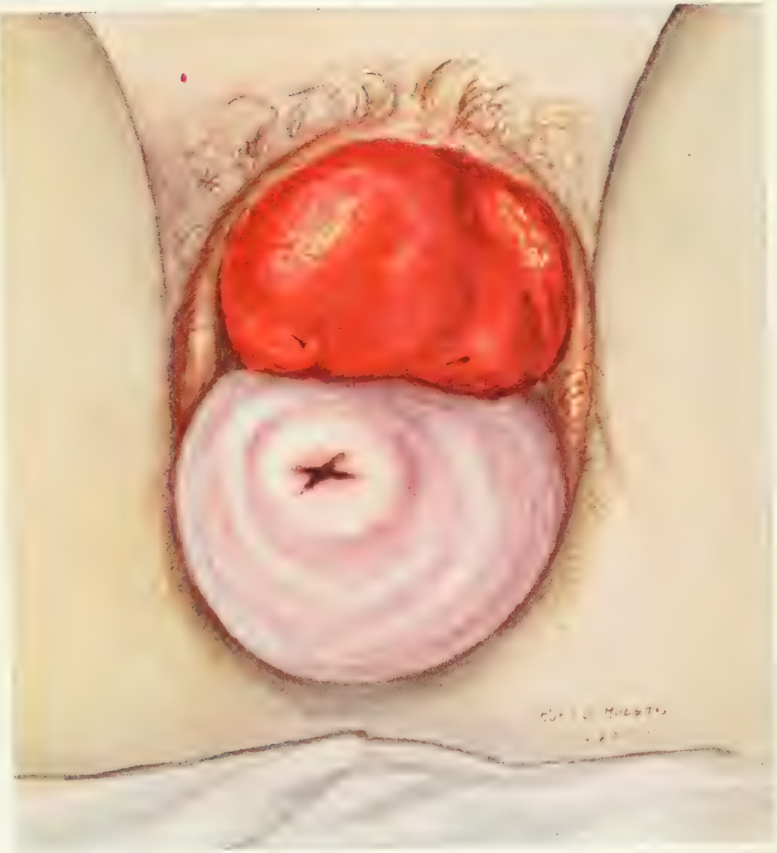
2. Any effort to construct a continent bladder would be doomed to failure.

3. The everted, prolapsed, diseased bladder mucous membrane could not be advantageously utilized in any conceivable operation, therefore why save it?

4. Reduction of the procidentia and ventral fixation of the uterus would permanently relieve the patient from the annoyance of the protruding mass.

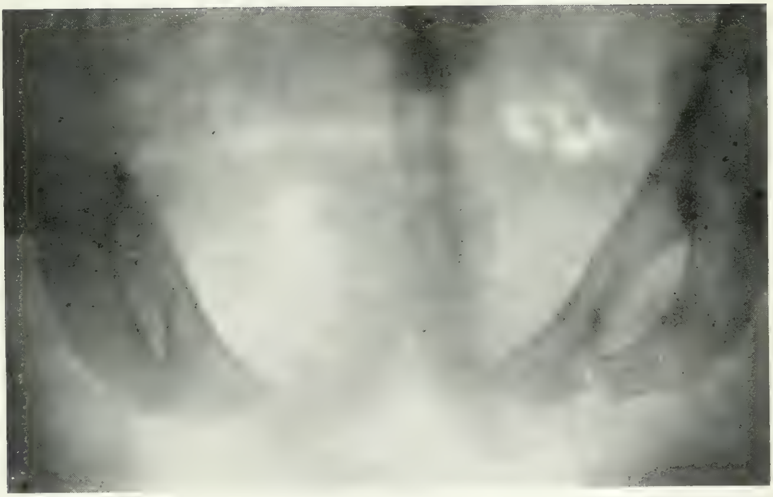
5. Removal of what remained of the bladder, transplantation of the ureters to the vaginal wall, closure of the defect left after

FIG. I.



Procidentia and eversion of the bladder in a young woman of twenty-one years, as an indirect result of a criminal assault when she was four years old.

Fig. 2.



Loss of the pubic arch, apparently as the indirect result of a criminal assault upon a girl four years of age. Skiagraph exhibit seventeen years after.

the bladder was removed and ventral fixation of the uterus was decided upon as most likely to contribute the greatest amount of relief.

This was explained to the patient with the fact that the operation would not stop the leakage of urine, but that it would hereafter emerge by way of the vaginal canal. She eagerly accepted any plan which afforded relief from the wretched condition she was then suffering and added " that the mere leakage of urine, to which she had accustomed herself over a period of seventeen years, would be of such trifling moment in comparison with her present condition that she should consider herself fortunate in securing the relief offered by the proposed operation."

Operation was performed in accordance with the plan above outlined. The whole of the remaining bladder mucous membrane was dissected away. The ureters were transplanted to the vaginal mucous membrane and sutured in place. The defect left by removal of the bladder was closed by deep and superficial sutures. An opening was then made above the pubis and very firm ventral fixation of the uterus effected by entangling the fundus with the recti muscles and fascia.

Prompt and uncomplicated healing followed with entire relief, except the irremediable one of urinary incontinence.

ARTERIOVENOUS ANEURISM OF THE EXTERNAL ILIAC VESSELS, WITH WOUND OF THE EXTERNAL ILIAC VEIN.

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OF HAGERSTOWN, MD.

ARTERIOVENOUS aneurisms are not usually seen by surgeons until some months or years after their occurrence, when they come for operation, as a rule, for relief of circulatory disturbances caused by the back-flow of arterial blood through venous channels to the heart. Unable to withstand the constant arterial beating, the right chamber gradually gives way until relief is afforded by proper treatment of the aneurism. Certain local circulatory disturbances are, to be sure, always manifest in the affected extremity, but it is surprising how little real trouble is thus caused—until, perhaps, it becomes aggravated by the heart complication. This is, therefore, the real reason why arteriovenous aneurisms are seen so late in their course—the unfortunates either succumb before medical aid reaches them or, surviving the first shock, they are so slightly disturbed as to render operative interference unnecessary. Occasionally, however, the rule is broken and a case in point, most unusual and instructive, is the following:

On July 27, 1913, a little boy, L. W. G., aged seven, fell while playing with a pair of sharp-pointed scissors; in falling his abdomen was penetrated by the blades of the scissors, the points entering together (there was only one wound) about one inch to the inner side of the right external iliac crest and parallel to it. The boy was picked up by his mother who noticed but little blood coming out of the wound. A few hours later the family physician, Dr. S. H. Gardner, probed the wound, but finding nothing, had the boy kept at rest in bed for further observation.

In the course of the next few days, a small pulsating swelling developed in the right iliac region in the vicinity of the wound, and coincidently the patient showed a slight elevation of temperature. No complaint was made of the right leg, but the abdominal mass seemed to increase just a little each day and had almost filled the right lower quadrant by the third day when Dr. Wroth was called in for consultation. A careful examination then elicited the fact that there was a visible pulsation over the mass and a definite systolic thrill present in or transmitted through it. Pulsation was barely perceptible in the femoral artery just below Poupart's ligament, but was absent below this point in the femoral, popliteal and dorsalis pedis arteries. The affected leg felt definitely cooler than the other, whose circulation was perfectly normal. There was no diminution of sensation; and motion, as far as it could be tested, was good. The boy was brought in to Washington Hospital, Hagerstown—he lived in the country—for observation and operation if necessary.

By Sunday, August 3, one week after the accident, the swelling had almost imperceptibly increased in size until it entirely filled the right lower quadrant of the abdomen and even seemed to project a little beyond the mid-line. It was so tense that we dared not attempt to elicit fluctuation, although we felt sure of the fluidity of its contents. The thrill, as noted by Dr. Wroth, was still present, and seemed more easily felt than ever. Definitely systolic in character, it could be traced down the femoral artery by means of the stethoscope for about two inches where it was lost, and beyond which point pulsation could not be felt in the vessel. The condition of the leg was as first noted. The temperature was 102° but there was no abdominal distention, no pain, no signs or symptoms of peritonitis—the abdomen was perfectly soft everywhere except in the region of the swelling. In short, it seemed as if the damage was extraperitoneal and, as will be noted later, such was the case.

The tract of the wound was definitely infected and this compelled us to consider the possibility of a localized abscess having developed on top of the iliac vessels and thus giving the transmitted pulsation and thrill, or an abscess in the vicinity of an arteriovenous aneurism of the iliac vessels. After careful consideration, however, the conclusion was reached that we had to do with an arteriovenous aneurism through which a very slight, a very gradual, but a constant leakage was taking place. The boy was quite pale by this time, his pupils were dilated, his pulse was rapid, he was beginning to show signs of loss of blood. The time for operation had arrived.

The patient having been prepared according to the iodine technic, a God-send in cases of this sort, tapes were passed around the femoral vessels just below Poupart's ligament in order to control any back-flow that might occur; the abdomen was opened through a generous mid-line incision and tapes were placed around the aorta and vena cava just above their bifurcation, to control any sudden hemorrhage that might occur from above. Pulsation was as strong in one vessel as in the other, confirming our diagnosis of arteriovenous aneurism.

Before proceeding further, we had Dr. W. D. Campbell, the second assistant, compress with his two thumbs both aorta and vena cava [1] against the underlying vertebra, and ascertained that by this means practically all pulsation in the swelling could be accurately and absolutely controlled as long as the thumbs held out. Therefore, Dr. Campbell having placed his thumbs in as comfortable a position as possible and all pulsation in the tumor having ceased, the peritoneal covering of the hæmatoma was incised at its most prominent point, liberating about a half liter of dark, mostly unclotted, blood which, in spite of aortic and caval compression, welled up in the cavity as fast as it could be sponged out, effectually blocking all attempts to locate visually the site of the injury to the vessels. Packing was temporarily resorted to, after which, by removing part of the gauze and having Dr. Campbell ease up a bit on the aorta till pulsation could be felt, the vessels were definitely located. Ligatures of umbilical tape were passed around both artery and vein and tied, two well above and two well below what was considered the site of the fistula. Suture of the wounds was out of the question owing to the critical condition of the patient who had, by this time, lost considerable blood.

Desiring to close up as quickly as possible and congratulating ourselves upon successfully getting out of an embarrassing situation, all packing was being removed from the aneurismal cavity when to our consternation there was a gush of dark venous blood, coming apparently from the lower end of the cavity. Hurried palpation in the depths revealed a hole in a vessel large enough to accommodate the tip of the ring finger, which, acting as a plug, prevented further hemorrhage. Heavy ligatures were passed both above and below this opening, but before tying them, the vessel was brought up into view when it was seen that the wound was a longitudinal slit about two centimetres long in the dorsal wall of the external iliac vein about one inch before it passed under Poupart's ligament. There was no corresponding wound in the artery. The ligatures were tied and the bleeding ceased.

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[1] This seemed less dangerous than twisting or clamping the tapes, which were to be used only in the direst necessity.

The condition of the patient was now most critical. Pulsation at the wrist could not be obtained and respiration had all but ceased. A hurried transfusion, by means of the two-piece emergency tube[2] devised by one of us, was done from father to son, during the course of which closure of the abdomen was proceeded with. By the time this was completed, the patient was awake and pleading for water. He went off the table in fairly good condition. His convalescence was uninterrupted and, strange to say, at present his right leg is as good in every respect—sensation, temperature, motion, strength—as his left. Curiously, too, pulsation cannot be elicited in the femoral or popliteal arteries, yet there is pulsation in the dorsalis pedis, a strange anomaly of collateral circulation. There can be little doubt but that the interval of one week which elapsed between the time of the accident and the time of operation was of distinct benefit to the establishment of the collateral circulation, which is responsible for the good condition of the limb.

Reverting to the findings at operation, the question of their explanation naturally arises. There were certainly two separate and distinct vascular wounds (1) an arteriovenous fistula between the external iliac artery and vein and (2) a longitudinal rent in the dorsal surface of the vein separate and some distance from the fistula. It is impossible to question our diagnosis of the existence of a fistula because the thrill, the diminished pulsation in the femoral artery and the absence of pulsation in the popliteal and dorsalis pedis arteries can be explained in no other way. Nor can it be doubted that we cured this lesion in view of the fact that, although we were unable to find the actual site owing to the desperate condition of the patient, ligation proximal and distal to what we considered the site—it will be recalled that the circulation was temporarily cut off and no thrill could be felt as a guide—dissipated the cardinal signs of such a lesion, namely, the thrill and the caval pulsation. This point granted and the hole in the vein having admittedly no relation to a hole similarly placed in the artery (careful though hurried search was made for this), the question may be asked, "How did these two separate and distinct wounds occur when there was only one point of entry of the implement which caused them?" The answer, in our judgment, is that the scissors were closed when they entered the abdominal cavity, but, when the handle struck the floor, the sudden jar caused the blades to open with the result that, the sweep being about parallel to the vessels, one blade passed between them, cutting a hole of equal size in their approximate surfaces and causing the fistula, while the other, sweeping downward, caused the rent in the upper surface of the vein at some distance from the primary lesion. Most of the arterial blood then, was immediately shunted over to the vein, as is usual in such cases, only to strike a set of valves a short distance beyond the fistula and be hurled back to the heart through the vein. A small volume of blood passed on down the artery to the leg and was distributed in the usual way. It returned through the usual channels until it reached the rent in the vein when it gradually leaked out of the vessel, giving rise to the hæmatoma as noted. That this formed so gradually is due in part to the diminished supply of blood going down to the leg, and in part to the probable formation from time to time of occluding clots. Had relief not been afforded, the boy would undoubtedly have bled to death within his own abdomen.

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[2] Bernheim, Bertram M.: An Emergency Cannula, *Jour. Am. Med. Assoc.*, April 6, 1912.

It would take us too far afield to consider the question of ligation of the external iliac vessels[3] in its relation to gangrene of the leg. Suffice it to say that gangrene does occur following ligation at this point more frequently than at any other along the vessels of the leg.[4] The reason for this awaits explanation. We had every reason to expect gangrene in this case and were amazed that it did not follow.

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PERFORATING GASTRIC AND DUODENAL ULCERS.*

WITH REPORT OF CASES.

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I HAVE tabulated the following list of cases for publication because it is a condition, in my opinion, more commonly overlooked in its acute stages than any other surgical malady, and for that reason it seems to me that too much cannot be said on this most important subject, and I therefore have published these cases with these few remarks.

Acute perforation of gastric or duodenal ulcers is by all odds the most serious, and, I might say the most tragic, disaster that can happen in the human body. Usually it is a sudden disaster, coming upon a patient from whom you can generally elicit a history of disturbed and imperfect digestion, with attacks at varied intervals of marked indigestion. This, at best, can be gotten, even if the ordinary typical clinical symptoms of gastric or duodenal ulcer are not elicited. These patients bear their burden, go on from week to week, and all at once, like a thief in the night, and oftentimes, according to my records, without any premonition or warning whatever they are seized with severe upper abdominal pain of a violent character, immediately followed by marked peritoneal shock. I know of no condition where the change from apparent health into a condition of great gravity is more pronounced and more marked than in these acute perforations; no disaster in surgery more imminently perilous; none so seldom recognized early; and, in consequence thereof, followed invariably by a fatal issue unless early surgical intervention is resorted to. Those operated on in the first five hours usually recover. After ten to fifteen hours the majority in the past have died. I mention this to show that in these cases we have the patient put more rapidly in a perilous condition than from any other intra-abdominal malady that I know of. The picture of peritoneal shock and rapid and oncoming collapse with a scaphoid abdomen, hard and rigid as a board all over, soon changes and the symptoms of rapid peritonitis are pretty speedily noted.

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* Read before the meeting of the Medical Chirurgical Faculty, April, 1912.

One of the first notable contributions to the subject of duodenal ulcer and its surgical treatment was the address of the President of the American Surgical Association in 1900, Dr. Robert F. Weir. The total number of cases then reported was small and nearly all of them were acute perforations into the free peritoneal cavity.

In most of the recorded earlier cases a correct diagnosis was not made before operation, and all the symptoms sufficiently urgent to demand immediate operation and the true condition found at operation. In many of the later cases an accurate diagnosis, fortunately, has been made before operation, due to the typical syndrome of symptoms, which, when observed, more and more certainly speak for the occurrence of this serious disaster, and in consequence of early operative interference being resorted to, many lives have been saved.

The condition is most frequently mistaken for acute appendicitis, because the pain a few hours afterward is more commonly referred to the lower abdomen. Also, it is frequently mistaken for acute hemorrhagic pancreatitis. If close attention is given to the history in each case, there will be noted prior to the oncoming of urgent symptoms the history of previous indigestion, extending in most cases over a long period, with attacks of pain in the epigastric region, with regurgitation of acid secretion, not only during the period of digestion with food, but also from a stomach empty of food, at a time when it should be free of acids. These symptoms can be usually gotten in the history before the symptoms of the attack of perforation makes itself manifest, which, when it occurs, is so markedly accompanied by such sudden, severe pain in the epigastric region, followed immediately by pronounced peritoneal shock, with the rapid oncoming of a board-like and scaphoid abdomen, should make the observer in each case when such symptoms are pronounced, turn his attention to the region of the stomach as the cause of them, and think of a gastric or duodenal perforation as being at the bottom of this fulminating, acute, and collapsing condition, which becomes hourly more and more pronounced, until the chances of relief being offered by operation are exceptionally slight. It is certainly the one condition of all others where even a few hours of waiting costs the life of the patient.

In the slow perforations and early in the acute ones the extravasated material passes down the right side of the abdomen over the omentum, or to the outer side of the colon to the right iliac fossa, and here gives rise to tenderness and rigidity, but it is to be borne in mind that in these cases there is also associated acute tenderness and rigidity over the perforation above. The board-like and scaphoid abdomen is always present early, and not until there is a diffuse peritonitis does the abdomen become distended. With such a picture, immediate operation is called for always, and when the stomach history is elicited, as I have above stated, perforation should be suspected after the elimination, as far as possible, of other conditions.

In all of the cases I have come in contact with the pain has usually been in the epigastric region in the early stages, of a sharp, sudden, and agonizing character, and the abdominal rigidity early becomes general and board-like. The scaphoid and rigid abdomen constitutes, in my mind, one of the most marked and valuable signs of perforation, and continues until the peritonitis advances. Then the distention is noted. Distention is never noted in the early stages, and when noted, indicates a degree of peritonitis from which the patient will seldom recover.

Collapse is a variable occurrence. It takes place early, as a rule, and may be profound. Arrest of intestinal peristalsis occurs only after the peritonitis is sufficiently advanced to produce paralysis of the intestines. It is of no special diagnostic aid. The absence of liver dulness, associated with a scaphoid and rigid abdomen, is an invaluable sign of perforation. When the distention has come on, the diminution or absence of liver dulness is of little value.

Temperature in the early stages is usually normal, subnormal, or but slightly elevated. Seldom is high temperature noted. Pulse rate is increased, the pulse becoming very weak, thread-like, and rapid if collapse is present. Usually, the respiration is entirely thoracic and shallow, and the respiration rate increased. Leucocytosis is noted early, but more marked as the case advances, going as high in some of my cases as 30,000. I do not lay much stress on the dependency to be put in leucocyte count as an aid in the diagnosis in the early stages of perforation. The previous history of the patient is of great importance, and when associated with the symptoms of agonizing, stabbing pain in the epigastric region, followed by shock and collapse, attended with vomiting, subnormal temperature, rapid, thread-like pulse, accompanied with a board-like scaphoid abdomen, with or without rise of temperature, we have here a complete classic and ominous picture of a perforating peritonitis, of either duodenal or gastric origin.

The symptoms in duodenal ulcer in most cases are perfectly characteristic, and admit of an unhesitating diagnosis. Sometimes they exist without any symptoms until a sudden and perhaps fatal hemorrhage or perforation declares its existence. The pain in a measure differs from that of stomach ulcer. It is produced by the irritation of the open ulcer by the hyperacid gastric juice, and comes on after the stomach digestion is complete. In other words, it is more noted just before meals. (Coming on just before meals it is often called " hunger pain," and the patient usually finds that something taken will relieve the pain. This is explained by the pylorus closing when there is food in the stomach and the hyperacid juice no longer gains access to the duodenum.) It sometimes occurs significantly in the small hours of morning. It is of a burning character, and located in the right midline, or along the costal border. This colicky pain is caused by pyloric spasm.

These patients often do not restrict their food to any great extent, and there is no appreciable loss of weight in the early stages. As the ulcer continues, however, the pain becomes more constant, the diet is often cut down, the patients are underfed, and emaciation results.

Treatment.—From my limited experience I am convinced that success or failure in the treatment of perforating gastric or duodenal ulcer depends almost entirely on the time which elapses between the perforation and the operative repair.

Gibbon and Stewart report a series of twenty-two cases of perforation, and out of the twenty-two there had been ten deaths. In thirteen cases operated on within seven hours, all but one recovered, while the remaining nine, all operated on after twenty-four hours, died. These figures are striking and significant, and other operators' statistics are in accordance. This experience has been noted in my series of cases, and although one case (Case I), was not operated on for three days following the onset of his perforation, he still recovered. It is perfectly possible that an occasional case will be saved, although operated upon late. Still, the point is that usually one chance of saving life is early and complete operation. This I wish to emphasize. The importance of operating as soon as the early symptoms already enumerated have been noted. If distention is waited for, what does it mean? Late peritonitis, with very slim chances of saving life.

Since this condition is so commonly mistaken for appendicitis, the primary incision is oftentimes made in the lower abdomen, and when one recognizes the character of the fluid, a rapid elimination of the appendix and the pelvic organs should be made, and a wet gauze tuck of salt solution should be placed down in the pelvis and left for a temporary drain. The upper abdomen should be at once opened by a second incision. (I consider it very unwise to extend the incision from the lower to the upper abdomen, but make the second incision always, because of the lesser damage to the abdominal wall. Of course, the first incision is not closed, but left to drain while the work is being attended to in the upper abdomen.)

When the peritoneum is opened, one is usually directed immediately to the seat of the perforation by the exudate, which is, as a rule, found in the immediate neighborhood of the perforation. The method of closure must vary with the character of the ulcer, and especially with the degree of induration to the perforation. I usually close it by a mattress suture of fine silk. If the ulcer, whether gastric or duodenal, is very close to the pyloric orifice, care should be observed not to close the pylorus too tightly. I have not yet found it necessary in any of my cases to resort to a gastro-enterostomy.

Mayo reports twenty-seven patients operated upon for acute perforation. " In five, primary gastrojejunostomy was also done, with two deaths. In twenty-two, closure of the perforation alone was made, with abdominal drainage, and but one of the eighteen who recovered required a secondary gastrojejunostomy, the perforation having seemingly put an end to the disease." He believes that an excavating ulcer does not become cured unless excised, or unless nature cures it by a perforation, so that it has been found seldom necessary to do a gastro-enterostomy if the perforation can be satisfactorily closed. Where it has been satisfactorily closed, the next step in the operation is to institute proper toilet of the peritoneum, and proper drainage. As to the question of irrigation which at once arises, I personally do not make use of it. I believe that well-placed suprapubic tube drainage, with gauze protected by rubber tissue, is all that is necessary.

Suture of the perforation with pelvic drainage with the patient being subsequently placed in the exaggerated Fowler position gives the best results. The mooted question concerning whether or not a gastrojejunostomy shall be done at the same time usually is not necessary if the perforation lies, as I have just said, near the duodenum or in the pylorus, it should be sutured transversely to avoid a stricture of the lumen occurring at this point.

My chief objection to doing a gastro-enterostomy in the height of a peritonitis of this kind is the additional shock added to the patient, and from the fact that it is not usually found necessary. What is necessary is more or less prompt speedy operation, without adding undue shock to a condition which is already most precarious. The justification for this gastrojejunostomy in the majority of the cases is very questionable, and only a few cases are reported where the subsequent gastro-enterostomy has been called for. The later treatment of these cases varies a little from the ordinary case of peritonitis. The Fowler position, continuous normal salt by rectum by the drip method or the Murphy method are immediately begun, and in this way large quantities of salt solution are immediately taken up. Nothing is given by mouth for a certain number of hours, relying on the fluids taken by rectum. The question of posture is one on which the surgeons differ. I, for one, believe much good comes from the Fowler position.

The cases are presented chronologically.

BRIEF SUMMARY OF CASES.

Case I.—Man aged thirty-eight. Entered with diagnosis of peritonitis; cause, perforating duodenal ulcer; lower abdomen opened and drained; result, died. Autopsy showed the perforation to be duodenal.

History.—He was brought to my service at St. Joseph's Hospital during my absence from town. He had a well advanced peritonitis, and was operated on by another operator, on account of my absence, and a lower abdominal incision only made use of. They found free pus in the abdomen and looked for the appendix and found it not at fault, and the man's condition was such that they only instituted pelvic drainage and did not open the upper abdomen for further inspection. He lived for eight or ten days, and died. An autopsy was gotten, and showed the cause of the peritonitis to be a perforating duodenal ulcer. The perforation was still open and leaking, and was located in the first portion of the duodenum. This was the first case that ever came in my service. It was some years ago, very little was known about the perforating ulcer being the cause of peritonitis, and I presume that this explains why the upper abdomen was not opened.

Case II.—Man aged fifty; came into hospital May 7, 1907;

operation declined and he died the next morning. Autopsy showed a general peritonitis, caused by a perforating duodenal ulcer.

History.—In my service at St. Joseph's, May 7, 1907; man aged fifty. He was taken acutely ill with severe upper abdominal pain and vomiting on the fifth, two days prior to coming in. This persisted, and he entered the hospital on the night of the seventh. I saw him at eight o'clock, one hour after his entrance. He then had a tense, rigid abdomen; leucocyte count 13,000; pulse wiry, small and extremely bad; hand and fingers cold, and his condition was most unpromising. I offered operation; it was declined. He grew rapidly worse and died on the morning of the 8th. The belief was, and the diagnosis was so advanced, that he had a perforating gastric ulcer. He had been a hard drinking man and gave suspicious history of gastric ulcer in that he had previous attacks of vomiting, the vomitus containing blood, with upper abdominal pain.

NOTE (May 11).—An autopsy was gotten and a general peritonitis revealed, the cause of which was a perforating duodenal ulcer. The ulcer was just distal to the pyloric orifice and the peritonitis was rather advanced, having existed since the night of May 5. From the time of the perforation to the time I saw him was forty-eight hours. His condition, as I above stated, was that of a man profoundly shocked, practically in extremis. Operation was declined, and he died the following morning.

CASE III.—Mrs. L. L., aged forty-five; residing in this City; operated on June 30, 1908; perforating duodenal ulcer; operation thirty-two hours after onset; recovery (Martin).

History.—I was called about six o'clock on the evening of June 30, 1908, by Dr. J. G. Wiltshire. The patient's previous history showed that she had been a delicate woman and had been in the hands of many doctors; had been treated for many years for retroverted uterus; five years ago she was operated upon by a leading gynæcologist for a ventral fixation. She had been more or less of an invalid ever since, not altogether laid up, but having various and sundry complaints. There was no definite stomach history, no vomiting of blood, no occult blood in the stool, no special symptoms of gastric discomfort given in the history. On June 29, thirty-one hours prior to my seeing her, she was seized with acute abdominal pain and vomiting. This persisted all the afternoon and night of the 29th, up until the morning of the 30th. Various and sundry efforts were made to move bowels without success; numerous medicines; numbers of enemas, and even croton oil, were given. I saw her about six-thirty on the 30th; mouth temperature 100°. The picture presented was that of general peritonitis; limbs were drawn up; abdomen tense, tight, and very much distended; principal pain on palpation was over the appendix region. I expressed the opinion that she had a general peritonitis from some cause, and advised immediate operation.

Operation.—She was sent at once to the Union Protestant Infirmary, and preparations were made for immediate operation. Under ether the abdomen was opened through the right rectus. As soon as the peritoneum was opened thin pus welled out from every direction. It was then noted that this pus was also markedly bile stained. I immediately sought for the appendix and found it almost entirely obliterated except about a quarter of an inch of cæcal end; no inflammation. This was eliminated as a cause. Pelvis was explored, no trouble there to account for peritonitis, nor was there any evidence of a ventral fixation having been done. Both ovaries had been removed. A gauze pack wrung out in salt solution was put in the pelvis and left. I then proceeded to open the upper abdomen, making the usual incision through the right rectus. A quantity of exudate was noted as soon as the peritoneum was opened, which extended up in the gall-bladder region and under the liver. The pylorus was seen, but nothing found to be wrong in that region; a certain amount of exudate all around the sub-hepatic area and about gall-bladder. Gall-bladder was tense, but no perforation could be seen in it. In lifting liver and pulling it out with the retractors and pushing stomach over, an opening was found in the duodenum, looking at first as though it were in the common duct. The tissues all about were necrotic, as likewise was the pancreatic tissue covered with necrotic exudate. In getting away the exudate and opening up the parts, the opening was seen, as I above said, in the duodenum, in and about the region of the common duct. Bile poured out from this opening very freely, and it was thought that the opening was in the common duct pure and simple. In fact, a small common duct stone came out with the outpour of bile. The gall-bladder was somewhat distended with bile, and a stone felt in it. It was opened, the stone removed, and a tube introduced for drainage. Impossible to get at this opening in the duodenum to close it; a drain was left at that point, also one in the gall-bladder, iodoform rubber tissue tucks placed down into the sub-hepatic space, and the opening in the duodenum and the wound closed up around these drains. Bile poured out very freely. Then a tube was placed into the pelvis through the lower opening, several rubber tissue tucks placed around it, and the wound closed up around the drain tracts; cat-gut used, except for the skin; *no irrigation of the abdomen made use of.* She was considerably shocked when she went off the table and intracellular salt was given, 1000 c.c. She was put in the Fowler position and the Murphy salt drip method by rectum was instituted.

Post-operative History.—The patient's convalescence was uneventful. For a number of days there was a great outpour of bile from the drains in the upper incision, but the wounds ultimately closed and the patient made a nice convalescence. In the summer of July, 1911, she returned to the Union Protestant for the closure of a ventral hernia, which occurred at the drain tract in the lower incision. This was closed and a good recovery made. The patient is still living and in good health at the present date.

CASE IV.—Mr. J. P., aged fifty years; University Hospital; perforating duodenal ulcer; drainage through three incisions; operation December 2, 1908, two weeks following the first symptoms of the perforation; result, cured.

History.—Patient fairly well-developed white man, fifty years of age; had been under the care of Dr. Slade, his physician, for two weeks with the history that the initial symptoms were pain, which came on suddenly in the upper abdominal region, which continued spreading to the right hepatic region and off into the right side. He suffered great pain, and had what he called "tremendous sweats," principally at night, when his clothing would be soaked. He had fever continuously, and marked tenderness in the upper abdomen. I saw him in consultation out in the country the night of the 26th and advised him to be brought into hospital immediately for operation. He had then symptoms of general peritonitis. The diagnosis was thought to be appendicitis. In palpating his abdomen I was convinced that he had definite suppuration in the upper abdomen as well as the lower abdomen, and expressed the opinion that I did not think appendicitis was the cause, but more than likely that it was due to a perforating gastric or duodenal ulcer. The abdomen was markedly distended and tender universally on pressure, particularly in the right side and above the umbilicus. He was not entered into the University Hospital until mid-day of December 1. When I saw him he presented such a haggard facial expression and was so completely "all in," as it were, that I thought it unsafe to attempt any operative procedure that day, as I did not believe he would live through it. His rectal temperature was 104°; leucocyte count 33,000; pulse 130. He was put in the upright sitting posture and salt solution given both intracellularly and by rectum. The following day, December 2, I decided to operate. He was practically no better. His leucocyte count was 35,000; pulse very quick and of no volume; rectal temperature subnormal; he looked badly, had a bluish, cyanotic tinge of skin, and presented a picture of rapid going down from abdominal suppuration.

Operation.—This was performed in the early morning of December 2. The abdomen was opened by an incision in the lower abdomen, a quantity of pus and yellowish fluid escaped, with some gas. The whole abdomen was in an advanced stage of general peritonitis, pelvis full of pus, and lots of exudate between layers of coils of intestines. On passing a hand down into the pelvis a lot of white, flaky pus welled out. Around the cæcum there was a lot of fresh exudate and a regular layer of exudate one-sixteenth of an inch thick. The appendix was covered over with this exudate. It was rapidly taken off, but there was no evidence of perforation in it, and it was eliminated as the cause of the peritonitis. A large gauze tuck wrung out in salt solution was placed in the pelvis and a second incision was made in the upper abdomen through the right rectus and as soon as the peritoneum was opened a huge abscess was gotten into, consisting of the same flaky pus. A quantity of exudate was all around in this region, around the liver and stomach and duodenum. There was no perforation in gall-bladder, but the exudate extended to the under surface of the liver and around the gall-bladder, and in this region a great quantity of pus welled up from the back. In separating the duodenum from the exudate holding it to the under surface of the liver, a large necrotic area was seen to extend into the liver and back toward the back. The exudate was wiped away and the perforation was seen in this area of duodenum, welling up under the liver. The man's condition was so wretched that I did not stop to suture this opening, but made a third opening in the ileocostal space in order to drain this large abscess into the subhepatic space, running down to the right side. The infection seemed to have extended into the liver, and practically giving him an abscess likewise in that region. At any rate the suppuration was so extensive and the exudate so great it was hard to say whether the abscess had extended into the liver proper or not. A large drainage tube was put from the back into this necrotic area of the liver, with iodoform tucks around it. Rubber tube drainage was also put into the upper incision, connecting with the tubes that ran in from the ileocostal space and down to the region of perforation. His condition was so extremely grave he was given salt solution while the operation was going on, and oxygen also was administered. After getting the drainage placed in the upper abdominal incision and the incision through the ileocostal space up under the liver, a tube was placed through the lower opening in the pelvis and the wounds closed around the drains. He went off the table in a condition of profound shock, and there was very little hope felt for his recovery. The suppuration was so wide-spread that it did not seem possible that he would come out of it.

Post-operative History.—It was noted he showed evidence of recovery from the shock and sepsis, and drained very, very freely through the numerous drain tracts. There was a considerable amount of bile from the posterior tract; the temperature and pulse showed a tendency to approach the normal line, and after a very stormy convalescence, and replacing of drains of smaller size, the wounds ultimately closed, and but for a setback which occurred on December 18, he steadily improved. It was noted on December 18 that he complained of a sharp pain in the left side of his chest over the seventh and eighth ribs. Auscultation over this area revealed a definite friction rub. With proper treatment instituted about three days later the pain subsided and friction rub disappeared. For about five days the patient ran a normal temperature and pulse and was getting on nicely. Two days later he ate a piece of cocoanut cake without permission, which was followed by intense abdominal pain, chill, temperature reached 103°, pulse 140, clammy skin, and profuse perspiration. The stomach was washed out, bowels moved freely, and he got some relief. His temperature and pulse ran irregularly for about a week and then came down to normal. I attribute most of these setbacks and sudden rises in his temperature and quickening of his pulse as due to recurring leakages that took place from the still unhealed perforation. About a month following the operation the drainage tubes were all removed and the tracts granulated up. About six weeks after the operation he left the hospital *cured*. This patient was one of the illest patients I have ever seen get well.

Case V.—L. S., aged twenty; operated on at St. Joseph's Hospital for perforating duodenal ulcer June 22, 1909, twenty-three hours after the perforation; result, died.

History.—This man was taken sick with violent abdominal pain on June 21, twenty-three hours prior to my seeing him, with what was supposed to be lead colic. He was seen by me late in the afternoon of June 22, when it was seen that he had general peritonitis, and his condition was rapidly growing worse every hour. Immediate operation was advised. He had a very feeble, wiry pulse, dry tongue, facial expression of a man rapidly dying from some poisoning. He was operated on shortly after his coming in, so there was no careful previous history obtained in his case. He was supposedly well, when he had this onset of severe, upper abdominal pain, which grew steadily worse in intensity and continued on with marked and progressive symptoms of collapse, showing themselves the day of his entrance. He had, when I saw him, evidence of general peritonitis; tense, tight abdomen, and beginning distention, so he was taken at once to the operating room.

Operation.—Lower abdomen opened; the peritoneum and cellular tissue just under muscle and between muscle and peritoneum were filled with jelly-like exudate, and as soon as the peritoneum was opened a quantity of yellowish, straw-colored fluid welled out. Fresh exudate was seen all over the intestines; in other words, there was a diffuse general peritonitis. This seropurulent fluid welled out in great quantities from all sections of the abdomen. It was likewise bile tinged. The appendix was sought for and seemed to be normal, covered with exudate, as likewise were the intestines all about. A hand was passed into the pelvis and a quart or more of this fluid welled out. A good deal was mopped out and then a gauze pack wrung out in normal salt solution placed in the pelvis for drainage. The second opening was made in the upper abdomen through the right rectus, toward the midline, and before the peritoneum was opened this same jelly-like condition in the tissues prior to reaching the peritoneum, as was noted in the lower abdomen, was also noted here. When the peritoneum was opened a great quantity of seropurulent fluid welled out in great abundance, with free exudate all over the stomach and omentum and adjacent structures. As the stomach was pulled toward the left side I saw a perforation in the duodenum. It was punched out like a bullet hole, about the size of a little finger, situated about one and a half inches below the pyloric orifice, and this quantity of fluid was pouring out. His condition was that of profound shock, with scarcely perceptible pulse. He was taking the anæsthetic badly, and became rapidly more shocked. The perforation was sewed up with several mattress sutures, which closed it completely, and a Lembert suture put in over this. No irrigation was used in the peritoneum. Drains were then placed and the abdomen closed up around the drain tracts, both in the upper and lower abdomen. The patient did not respond to any quantity of salt solution that was given him, but rapidly sank into more profound shock, and died from the peritonitis some ten hours following the operation.

Case VI.—Mrs. M. E., Amboy, W. Va., aged forty-three years; University Hospital; gastric ulcer, anterior wall; complicated with cholelithiasis and pericholecystitis; operation October 21, 1909. Result, cured. The ulcer had perforated, but was sealed off in the exudate forming adhesions around it. The perforation was opened up at the time of operation, showing a well-defined gastric ulcer. Part of the ulcer was dissected away and the opening closed. This case is of interest as occurring combinedly with gall-stone disease, having possibly at some time perforated, but was blocked and closed by exudate thrown out by an inflammation occurring about and around the point of perforation.

History.—A brief history of the case is as follows:

She was referred by Dr. James R. Cole. Eighteen years ago she had an attack of trouble with pain referable to the gall-bladder region, and off and on since then she has had attacks of pain in upper abdomen, etc. Last summer she had jaundice which lasted three months. She said she thought she had had no indigestion except when she had these attacks when there was a certain amount of gas distention; had lost some weight. I advised operation.

Operation.—Under ether I made my usual incision in upper abdomen to right of midline and came down to the edge of the liver and found a mass at the border of the liver, adherent to free border of liver, and pyloric end of stomach was intimately tied up in this mass, and the pyloric arm of the stomach was adherent to gall-bladder, and was tightly tied down by old adhesions. In packing off the subhepatic space and getting the liver up, the free border of the liver showed a cicatrix and this mass was adherent all along free border. In beginning dissection to free adhesions, I first tried to free stomach and in doing so the stomach wall gave way and some contents of the stomach came out. After getting it freed, I found the cause of this giving way was an ulcer which had become adherent to the free border of the liver and fundus of gall-bladder; after getting it freed, I sutured up this opening in stomach, inverted quite a little section so as to turn in opening, and closed it. This was about one and one-half or two inches probably from the pyloric orifice in the pyloric arm of the stomach, on the anterior wall of the stomach down toward the greater curvature. I wish to emphasize right here that this giving way was due to an old ulcer of the stomach, which had caused the dense adhesions to the gall-bladder. I then went on with the operation and did my usual cholecystectomy. She stood the operation well.

Post-operative History.—She made an uninterrupted recovery, and the last report was that she was thoroughly and entirely well, and had no disturbances whatever.

Case VII.—Mr. O. F., aged forty-four years; St. Joseph's Hospital; operation March 6, 1911, three or four days following the first symptoms. Result, died. This was a gastric ulcer with acute perforating peritonitis. He came in practically in a hopeless condition. Diagnosis was made briefly before the operation, and operative procedure was resorted to, but the operation was too long delayed and the patient was too badly poisoned and shocked to recover, and died some hours afterward. He was referred by Dr. Duncan.

History.—He was brought into St. Joseph's Hospital in a practically dying condition, with diagnosis of appendicitis. When I saw Dr. Duncan he told me he thought the man had gone down unusually fast. When I saw the man I found him practically pulseless and looked him over and in view of the history gotten, the rapid going down of the patient, with the early symptoms being located in the upper abdomen, I expressed the opinion that the man did not have appendicitis, but a perforated stomach ulcer and that I thought the chances of doing him any good very slim, because the perforation had gone too far and his condition of collapse was too great. I advised operation, however, and operated about seven o'clock that night. The history given me is as follows. He had been complaining of pain in the stomach and vomiting for three or four days and had been using a mustard plaster immediately over stomach, and this pain continued until he had *bad pain,* and Sunday afternoon, March 5, he was seen by Dr. Duncan and things were given for relief of pain, and the doctor, thinking it was probably appendicitis, decided not to act and waited until the next day, when he found the patient desperately ill; he had gone all to pieces. He did not bring him into the hospital until late that afternoon, and I saw him shortly after his arrival. I could make out no marked rigidity about appendix region, and with this history of long-standing trouble in upper abdomen I gave my diagnosis immediately as perforated stomach ulcer. I opened him through right rectus and found the abdomen full of a great pour-out of stuff from upper abdomen, and marked peritonitis. I ran my hand down into the pelvis, and pus just welled out from pelvis by the pints—just gushed out; gauze packing was put down in pelvis and then I opened upper abdomen and there was also evidence of peritonitis, and on pulling stomach forward I broke up adhesions that were around the pylorus and as I rolled out pylorus there was a huge hole in pyloric arm of stomach which was so callous and hard it presented the appearance of carcinoma. I take it that it was an old stomach ulcer which had been shut in, and these adhesions had given way and peritonitis had been the result. His peritoneum was overwhelmed with stomach contents, etc., and an advanced peritonitis existed all through the abdomen. He was practically dying; I closed the hole as best I could with mattress sutures and left in drain above and below. He was infused and sent back to the ward, and after a while he seemed to pick up and improve, but his pulse lagged and after a certain time he commenced to go down and died the following day.

CASE VIII.—Mr. W. S., aged thirty years; St. Joseph's Hospital; stomach ulcer; operation July 6, 1911, at least twenty-four hours after first symptoms of perforation. I saw him in the Dispensary at St. Joseph's Hospital. He had a board-like abdomen, and evidence of distinct peritonitis, with great pain in the epigastric region, and in fact it had extended into the lower abdomen likewise. The perforation existed twenty-four hours before; according to the history it occurred acutely and suddenly, with severe onset of symptoms. Result, died.

History.—Has had diseases incident to children; had pneumonia at age of seven years; has not had typhoid; has had influenza a number of times; has also been troubled with indigestion for fully five years past, and at times would become nauseated and vomit. Two days before his present condition came on he was riding along on the car and became sick; even before he got home he began to have sharp pains in his epigastrium. Habits are good; never drank to excess, but takes a drink occasionally; negative to venereal disease. He entered the hospital on July 5, 1911, complaining of intense pains in his abdomen with nausea and vomiting. The day before, July 4, he was taken with these pains, which recurred both in frequency and intensity until he came into the hospital. His facial expression was that of intense pain. Upon palpating his abdomen pain, tenderness, and muscular spasm were marked. Bowels were constipated, appetite lost, urine scanty, high colored with no cysts or albumen. Slight cough, with little expectoration, no spitting of blood. No swelling of his feet. Patient was operated upon July 6, and there was found a perforated stomach ulcer with a consequent general peritonitis.

Operation.—He was operated on certainly twenty-four hours afterward, and this stomach ulcer was found, and a diffuse peritonitis existing. He was treated by an opening in the lower abdomen, and things excluded there, and found to be in the upper abdomen. As I had previously stated, I thought it was a gastric perforation, still I opened in the lower abdomen to exclude any possibility of a perforated appendix as a cause of peritonitis. Then I opened the upper abdomen and found the perforation in the stomach with a great deal of leakage occurring.

The perforation was closed, drainage instituted both in the lower and upper abdomen.

Post-operative History.—For the first few days he bid fair to do well, up to forty-eight hours, and then his peritonitis flared up again and that continued to grow worse, causing his death, three days after operation.

Case IX.—Mr. B., aged sixty-six years; Hebrew Hospital; acute perforating duodenal ulcer; consultation May 18, 1911. Result, died.

History.—I saw him in consultation with Dr. Bagley, May 18, 1911, for acute inflammation of the abdomen, which had existed since the 16th. The whole history was that of a stomach or duodenal perforation with sudden onset and violent epigastric pain, rapid oncoming of shock, and a board-like abdomen existing at the beginning of the attack, followed by a distended abdomen, and when I saw him he was in a condition of full-blown peritonitis, with distention and pain, vomiting, no movements of the bowels, and there was some question as to whether he had an obstruction or whether it was an acute inflammatory condition. The whole history was one pointing definitely to a perforation of a duodenal or gastric ulcer, and I so expressed my opinion that I thought it was one or the other, and that the case was most unpromising; in fact, that the perforation, or whatever the cause of the trouble was, had existed since the 16th, and operative interference seemed unpromising. It was advocated, however, hoping it might be of some avail.

Operation.—He was taken into the Hebrew Hospital and operated on by Dr. Bagley. The findings at operation disclosed a perforating duodenal ulcer, and death resulted. This was a hopeless case from the fact that the time existing between the operation and the occurrence of the perforation was over forty-eight hours, and the perforation was so far advanced that death was practically inevitable.

Case X.—Mr. X., aged forty-nine years; St. Joseph's Hospital; operation April, 1911; result, cured. Duodenal ulcer perforating into the drain tract following an operation done for the drainage of his gall-bladder, or cholecystitis.

History.—He entered St. Joseph's Hospital during January, 1912, with symptoms of intestinal obstruction; was turned over to me with a case possibly of obstruction; considerable vomiting, and on opening the abdomen I made my incision in the upper abdomen because it simulated possible gall-stone trouble, and as I had seen several cases where the symptoms were similar; namely, those of apparent obstruction due to some infection about the gall-bladder, I made my incision over the gall-bladder region. In going over the intestines I found no definite evidences of obstruction, intestines were ballooned, but there was no trouble there. I found a cholecystitis, and did a cholecystotomy. The patient had rather a stormy convalescence. The drainage in his gall-bladder was left in, I take it, unnecessarily long, and finally closed. Some infection of his wound took place, and it gaped in the upper portion. The wound closed finally, and he went out. After some weeks he returned to the hospital with a discharging sinus at the old drain tract, and it was rather a foul smelling discharge, and apparently it was coming either from the stomach or duodenum. This discharge grew less after treatment and quiet, and gradually closed. Just what happened I was unable to say, except I thought possibly an ulcer of the stomach may have perforated into the drain tract, and so waited on him.

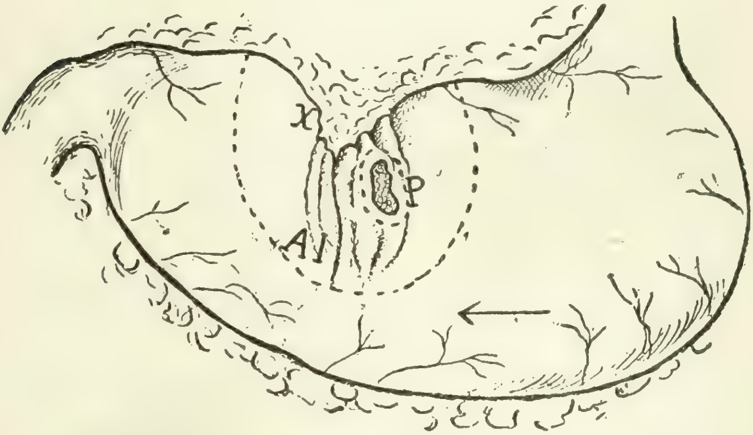
Operation.—In the middle of April his wound was about closed, and I opened down with a view of closing this ventral hernia, which was of a fair size. In dissecting up the adhesions I found an evidence of an old duodenal ulcer, which explained the above mentioned condition. This was such that I could turn it in. The infiltration was not extensive, so I made use of that procedure as a means of correcting the trouble rather than doing a resection. I turned it in, sutured the serous surfaces well over it, and closed his ventral hernia. He made an uninterrupted recovery.

CASE XI.—Mr. J. K., British seaman, aged thirty-eight years; University Hospital; perforating gastric ulcer; operation May 3, 1912; admitted to hospital April 8, 1912; complained of pain and discomfort in stomach for a year prior to operation.

History.—The brief statement that I heard in regard to him was that he was under care in hospital for stomach ulcer. On the morning of the third of May, my assistant informed me that there was a case they thought was perforated gastric ulcer. It had just been turned over to us about fifteen minutes before. The patient was in hospital in the medical services and on the night of the second of May he had bad upper abdominal pain and a rise of temperature, the chart showing that it had been running normal, and a rapid coming on of marked collapse, with, I presume, a stiffening of the abdomen. The patient grew rapidly worse, but my assistant's attention was not called to him until just prior to my entering the hospital, which was about ten o'clock. I saw him at once, and felt his pulse, which was very shocked, very wiry, and very rapid, and saw the facial expression of collapse and a distended abdomen. I did not stop to investigate further, but ordered him into the operating room, gave my opinion that with his history and the symptoms present, he had unquestionably duodenal or stomach ulcer perforation. He was taken at once to the operating room with a diagnosis made. His condition was bad. It had been a number of hours since this had happened, about fifteen or sixteen.

Operation.—I opened first his lower abdomen and a great quantity of gas bubbled out, and a great quantity of dirty looking and purulent material. I passed my hand down into the pelvis and this creamy looking substance came out of him in great abundance, a quart or more rolled out. I then did not stop to investigate the organs in the lower abdomen, but with this escape of gas and this great quantity of fluid and matter, I put a large salt tuck into his abdomen to let a certain amount of this be absorbed, and then immediately opened his upper abdomen. As soon as the peritoneum was opened gas escaped from there and a quantity of this same material was noted, and a lot of exudate was seen filling the upper abdomen. The material seemed to be welling out from an opening somewhere in the region of the stomach or duodenum, and, as I expected, the adhesions grew more and more as I worked my way up under the liver. The tissues there were covered with a dense layer of exudate, the material seemed to drain out all the way down. Under the liver there was a great quantity of exudate, and as I pulled the stomach forward I thought at first I saw the perforation in and about the neighborhood of the pylorus, but on getting things better opened up and tucked off, I found this to be a mistake, but that the perforation was right to the cardiac side of a big saddle ulcer, which extended down from the lesser curvature toward the greater curvature on both the anterior and posterior walls of the stomach, more or less fixing the stomach because of the dense infiltration extending out from this saddle-like ulcer into the surrounding tissues. It was held down in this position out to this marked infiltration and induration. This had produced a regular hour-glass contraction of the stomach (Fig. 1). All within the dotted line shows dense infiltration into the ulcer-bearing area to the greater curvature, leaving only a small way out for the cardiac pocket of stomach to the pyloric pocket of stomach, as shown by arrow. The perforation was at the point indicated by *P,* near the cardiac side of the ulcer and this material was just welling its way out from this perforation. It was just a small opening, but on examining it the walls were distinctly infiltrated, so I concluded to cut it out, excise the perforation, for several reasons. First, to get a good view of the ulcer, where it had extended through the different walls of the stomach, and finally through the peritoneum, showing this cone-shaped extension of it, and also in order to get sufficient material for microscopic examination, and third, because I fancied I was able to close the opening better than if I attempted to close and invert this opening by purse-string suture or whatnot. So with a knife I simply went around it as is indicated by the dotted line around the opening at *P*. Of course, the incision extended through the heart of the ulcer tissue. The dotted line at *P* indicates the

FIG. 1.



AI, area of infiltration; *P,* perforation; *X,* saddle ulcer with contraction. It was a saddle ulcer on a carcinomatous base, with marked carcinomatous infiltration. This is the first carcinoma of the stomach that I have had in my experience in which there was a perforation. All within the dotted line shows dense infiltration into the ulcer-bearing area to the greater curvature, leaving only a small way out from the cardiac pocket of stomach to the pyloric pocket of stomach, as shown by arrow.

line of incision around this perforation. This was taken out and then mattress sutures were put in, closing it. Several tucks were put up around the lesser curvature, where this exudate was, and over the sutured area, so if leakage occurred it would have a way out. Then rubber tissue tucks and a rubber drainage tube were passed into the pelvis and the wounds closed up around the drainage. The man had salt solution during the operation, and went off the table pretty badly shocked during the operation, but still holding his own. He soon reacted, made an uninterrupted recovery, and lived for a number of months. The microscopic examination of the section that I removed showed the infiltration around the ulcer was carcinoma. This had infiltrated all through to the back. It was impossible to do a resection of the stomach, so it was left as found, the ulcer simply being closed. The man recovered from this perforation, gained flesh, and lived a number of months, and finally died of the further advance of his cancer. By the way, it is the first carcinoma of the stomach that I have ever seen in which there was a perforation.

CASE XII.—Mr. J. K., aged forty-four; referred by Dr. A. H. Carroll; operated on June 28, 1912; duodenal ulcer.

History.—The findings in the case were ulcer, located on the duodenal side of the pylorus, and actually was a duodenal ulcer; and the ulcer was so thin that it was on the verge of perforating, and a radical pylorectomy, followed by a gastroenterostomy, was done. The patient made an uninterrupted recovery and has been restored to perfect health.

CASE XIII.—Mrs. T. P., aged thirty-two; referred by Drs. Oscar B. Beer and J. M. King; operated on October 12, 1912; duodenal ulcer.

History.—She came in with a history of longstanding upper abdominal pain and indigestion, and it was thought possible in this case that the case was one of gall-stones. At operation it was found to be a duodenal ulcer, situated about ¾ of an inch from the pylorus; that is, on the duodenal side of the pylorus, and on the anterior wall of this portion of the duodenum, the most common site of the ulcers in this area. A radical extensive pylorectomy was done and my method of closure resorted to, and a posterior gastro-enterostomy was done. In this case the ulcer was likewise just on the verge of perforation; necrosis of the bottom of the ulcer had gone through to the peritoneal coat and it was just ready to perforate. She made an uninterrupted recovery and has been entirely relieved. The last report from her was she was entirely well, able to eat all kinds of food, and enjoyed splendid health, and had an absence of her pain, which brought her to me for operation.

Case XIV.—Mr. W. I., aged thirty-two; referred by Dr. B. B. Brown; operated on March 12, 1913; gastric ulcer.

History.—For three or four years he had pain in the epigastric region, and he was brought to me by Dr. B. B. Brown. I operated, and here, likewise, the ulcer had gone deeply and was nearly ready to give way. A pylorectomy was done, followed by a gastro-enterostomy, with a very happy result.

Case XV.—Mr. H. H., aged twenty-seven; referred by Dr. A. H. Carroll; operated on June 11, 1913; duodenal ulcer.

History.—He was brought to me with a duodenal ulcer. A pylorectomy was done, followed by a gastro-enterostomy. He made a good recovery.

Note.—Cases XII, XIII and XV in this series are cases that were found at the time of operation to be typical duodenal ulcers just on the verge of perforation, and Case XIV was a gastric ulcer on the verge of perforation, and should by rights be classified as perforating cases, because the serous coat had not given way but the necrosis in all of the cases had practically gotten through the peritoneal coat. They were operated upon and in all of the cases a pylorectomy was done, the entire ulcer-bearing area removed, the gastric and duodenal section ends were closed by my special method of closure, and a posterior gastro-enterostomy done, and all of the cases made uninterrupted recoveries. Photographs of the ulcers and full record of the cases are published in an article by me in the *Transactions of the Southern Surgical and Gynecological Association,* volume xxv, "Gastric and Duodenal Ulcers, with Special Reference to the Method of Operative Procedure Employed."

Cases XIV and XV are recent pylorectomy cases which have not as yet been reported, and simply add to this list of ulcers which have been dealt with according to my judgment in the most radical and proper way to combat such cases; namely, by pylorectomy and posterior gastro-enterostomy.

ANALYSIS OF CASES OPERATED UPON.

My record shows 15 cases. There were 11 perforations and 4 on the verge of perforation, for which pylorectomies were done just before perforation occurred. To emphasize what I said about the frequency of duodenal ulcer, it shows a greater number of duodenal than stomach. In this list there are 10 duodenal and only 5 stomach perforations. 12 of them came to operation in my service. Of the other 3, one was operated on by another operator in my services and simply a lower abdominal incision made, with drainage, but with a fatal outcome. One other I saw and advised operation, but it was declined. The patient was practically all in at the time, but an autopsy was gotten, and the ulcer located in the first inch and a half of the duodenum was found, verifying the diagnosis. The other, I saw in consultation with another surgeon, the patient was in extremis, all in. He was sent at once to the hospital and operated upon, but with a fatal issue.

The cases that recovered, except one, bear out the important fact that if aid is gotten promptly and early, the chances of recovery are that much greater. In all of the ones that were lost in my hands, they were operated on over twenty-four hours after the beginning of the perforation.

There was one of my series, the most interesting case, that came to operation several days following the perforation. I take it that he must have had slow perforation, with final overwhelming leakage, which put him in almost an extreme condition. He was so ill when he came into hospital that I hesitated whether to undertake it. He had well marked peritonitis, and several openings were made in the abdomen, and one in the flank, giving him pretty free drainage, as there was a large collection up under the liver and lesser omental cavity. His condition was such that it was thought highly probable that he would not live to get off the table, but after quite a stormy period of illness he made a very excellent recovery.

The ages in these cases varied from twenty-one up to fifty or thereabouts.

PERITONEAL AND PLEURAL ABSORPTION, WITH REFERENCE TO POSTURAL TREATMENT.

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AND

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Practically every peritoneal surface has been utilized and every possible position assumed in postural methods of treating acute peritonitis. Though of recent origin this form of treatment has been almost universally accepted and is considered subordinate only to drainage in importance.

The basis for postural methods, as originally instituted, was v. Recklinghausen's claims (1863) of open channels or stomata, which established direct communication between the peritoneal cavity and the lymphatic system and thus afforded a ready explanation for rapid absorption of peritoneal fluids. These stomata, however, were thought to be almost exclusively limited to the central tendon of the diaphragm, and for this reason peritoneal absorption was considered restricted to this region. Though immediately accepted, v. Recklinghausen's claims were soon disputed. His observations were never substantiated and finally through the work of Kallosow (1893), Muscatello (1895), and MacCallum (1903), the stomata have been definitely proven to be artefacts; but Muscatello still maintained that the central tendon of the diaphragm was the exclusive absorbing area of the peritoneal cavity and that an intraperitoneal current carried the peritoneal fluid to this region. Although the peritoneum has since been considered a completely closed cavity, medical literature is still replete with theories and arguments based on the supposed presence of stomata.

The practical import of these claims was first evidenced by the proposal of Clark's[1] position (1897). Although Clark recognized the fallacy of the stomata, he based his position upon Muscatello's claims of almost exclusive diaphragmatic absorption and reasoned that by elevating the foot of the bed 20°, gravity would so hasten the normal current to the diaphragm and increase absorption that it would constitute an effectual prophylactic method against an ensuing post-operative peritonitis. He thus felt secure in discarding the customary drainage. Any claims of efficiency from this position were overbalanced by the general dread of ensuing toxæmia from the rapid absorption through the supposedly sieve-like diaphragm.

As an expression of this opinion, Fowler (1900) advocated the exact reverse or sitting posture for the treatment of this disease. Fowler hoped to retard the current to the diaphragm where absorption was thought to be very high and to collect the peritoneal exudates in the pelvis, where absorption was considered minimal.

As evidenced from his original publication Fowler's position is based upon a full assumption of the then disproven claims of v. Recklinghausen. That Fowler was aware of the evidence against the existence of stomata is attested by his "full knowledge of the alleged anatomical and physiological reasons" advanced by Clark in his review of the literature. Moreover, as will be shown subsequently, peritoneal absorption is almost entirely by the blood and not by the lymph as assumed by Fowler. The whole foundation for Fowler's position has consequently been disproven.

Deprived of its scientific basis, this position becomes a purely empirical measure, its reputation and validity resting on clinical statistics alone. The inadequacy of clinical statistics is demonstrated by the manifested skepticism, which is similarly based upon statistics both with and without this position. The complexity of the conditions with so many factors inseparably involved, the great variation in the severity of the cases treated, the difficulty of classifying cases according to the location and extent of the peritonitis, the virulence and character of the infecting organism, the individual resistance of the patient, the variety of treatments synchronously employed, necessarily subordinates the value of clinical statistics. Fowler's position, therefore, must by some chance acquire more logical reasons for its success than those given at its inception, more definite scientific proof of its value, or, failing in this, ultimately lose its place in the treatment of peritonitis.

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[1] We are informed from a personal communication that this postural method has been discontinued by Dr. Clark himself.

The basis for Clark's and Fowler's positions may be regarded as *physiological, i.e.,* the supposed difference in the power of absorption of different parts of the peritoneal serosa, principally the diaphragmatic. The basis for a later addition to postural methods may be regarded as *mechanical, i.e.,* the principles are gravity and the mechanics of abdominal drainage, absorption playing a minor or negligible rôle. In this group may be placed the postural methods of Coffey and Küster.

Owing to the difficulty of gravitation of fluids into the pelvis Coffey places the patient in the lateral or a combined lateral and head elevated position in order to collect and drain pus from the flank.

Küster utilizes the ventral position. Though he apparently utilizes capillary drainage he thinks drainage is greatest where the patient is so placed that the incision is at the most dependent point.

This paper [2] is intended as a résumé of an experimental study, in which an attempt is made to establish the scientific value of postural methods of treatment. For the opportunities of this study it is a pleasure to express our gratitude to Professors Halsted and Abel.

We have attempted to determine (1) whether the dread of infected material reaching the diaphragm is justified; (2) the manner and channels of absorption from the peritoneal and pleural cavities; (3) the rapidity and relative amount of absorption from these cavities in various postures; (4) the distribution of fluids as determined by gravity.

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[2] The amplified form of this communication will appear in the "*Beiträge zur klinischen Chirurgie.*"

Method of Absorption of Fluids from the Peritoneal and Pleural Cavities.—Until recently the peritoneal and pleural cavities have been regarded as integral parts of the lymphatic system, though the manner of absorption of the contained fluid was not clear. v. Recklinghausen (1863) first claimed open communication through stomata as mentioned above. Almost synchronous with the refutation of the existence of these stomata, doubt was thrown upon the lymphatics as absorbents of these fluids. Starling and Tubby (1894), Heidenhain (1896), and Hamburger (1895), working independently and along different lines, concluded that absorption was into the blood and not into the lymphatics. Starling and Tubby injected indigocarmine and methylene blue into the peritoneal cavity and found these colors in the urine long before they appeared in the lymph dripping from the thoracic duct. Later the colors were detected in the blood before the lymph. Heidenhain was unable to find any augmentation in the lymph flow following injections of large quantities of fluids into the peritoneal cavity. Hamburger demonstrated that the effect of poisons was not delayed by ligature of the left innominate vein, including the thoracic duct.

Muscatello and Meltzer have been the strongest exponents of lymphatic absorption. Muscatello's observations, however, were principally upon granules. Meltzer repeated the experiments of Starling and Tubby and noted the colors in the lymph before the urine. Mendel (1898) performed the same experiments and completely vindicated the claims of Starling and Tubby.

Our results are thoroughly in accord with those of Starling and Tubby, and Mendel. We have utilized phenolsulphonephthalein as the solution injected into the peritoneal cavity. This inert soluble chromogen is very stable, can be quantitatively estimated with accuracy in the urine. The excretion of phenolsulphonephthalein by the kidney is so rapid and so uniform under normal conditions that it may be treated as a constant. The urinary output represents absorption, minus a constant, and therefore negligible renal factor.

The results following intraperitoneal injections of phenolsulphonephthalein may be summed up as follows:

1. The appearance time in the *blood* is 2–4 minutes.
2. The appearance time in the *urine* is 4–6 minutes.
3. The appearance time in the *lymph* (thoracic duct) is 20–60 minutes.
4. The quantitative output in the *urine* for 1 hour is 40–60 per cent.
5. The quantitative output in the *lymph* for 1 hour is less than 0.1 per cent.

It can therefore be seen that the lymph plays practically no part in the absorption of these fluids. This is true irrespective of the position in which the animal is retained following the injection. The results are almost identical from the pleural cavity. Absorption of fluids from these cavities is therefore similar and almost entirely by the blood.

Absorption of Granules from These Cavities.—The manner of disposal of granules injected into these cavities has been much discussed. V. Recklinghausen thought their exit was rapid and through open channels. Dubar and Remy (1882) and Maffucci (1883) thought the granules were slowly taken up by both the blood and lymph. Muscatello (1895), though disproving the stomata, asserts that the absorption is lymphatic, rapid and limited to the central tendon of the diaphragm. Küttner (1903) thinks absorption of granules lymphatic and limited to the diaphragm, and upon this basis makes some very interesting clinical applications. We are indebted to MacCallum (1903) for a more rational understanding of the manner of absorption. He showed that foreign material is removed from these closed cavities by a very slow reactive process of phagocytosis, but most remains in the peritoneal cavity, to be encapsulated as foreign material. In our experiments we have been impressed with the extreme tardiness of granular removal from these cavities. After 2–3 hours few granules were found in the lymphatics or abdominal viscera, and at the end of this time granules were not observed in the lymph flowing from a cannula in the thoracic duct. It should be emphasized that the conditions of absorption were practically normal. No artificial pressure was used and the absorption was entirely ante mortem, thus obviating very serious objections. On account of the small amount of granular removal and the non-injection of lymph-vessels, we have been unable to throw any additional light upon the path of absorption of granules whether into the capillaries of the blood or lymph. Certainly there can be no stomata or free access to the blood or the lymphatics of the diaphragm or elsewhere, for granules of india ink or other granules of similar size.

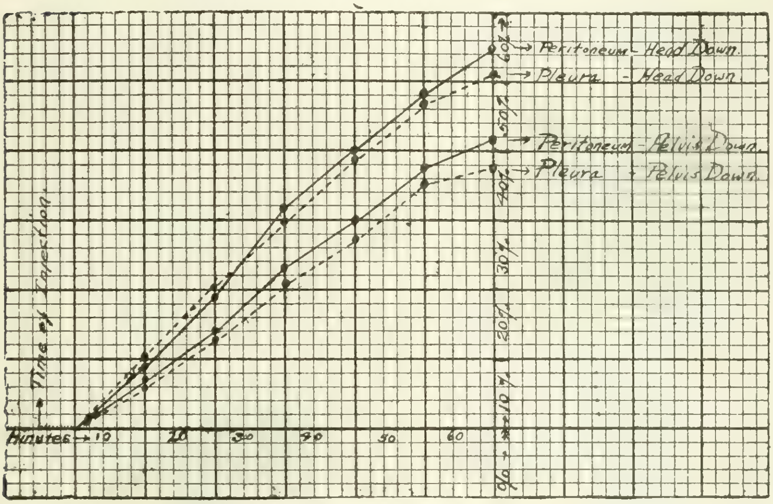
Absorption of Bacteria and Toxins.—Danielson, Wells and Johnstone, and Ruxton and Torrey have studied absorption of bacteria and have shown that practically immediately after injection of 4000 million bacteria as high as 35,000, and 5 minutes later as high as 200,000 per c.c. could be obtained in the blood. They think the absorption is lymphatic, but when we consider the tardiness of lymphatic absorption either of fluids or solids as shown above, it would not appear that the lymphatics could be considered such an exclusive factor in the absorption of bacteria, at least from the normal peritoneal cavity.

Oppenheimer has shown that toxins injected into the peritoneal cavity appear in the urine in 15 minutes, and that their absorption is not delayed by ligature of the thoracic duct. Injection of toxins by Hamburger produced toxic effects equally as rapidly and as thoroughly after elimination of the thoracic duct.

We can only conclude from a summation of the above experiments that lymphatic absorption of fluids from the peritoneal and pleural cavities has been greatly overestimated and that this absorption is almost exclusively hæmic. While our results have been mainly with fluids we feel that the results obtained by other authors on absorption of bacteria and toxins are so similar as to warrant the assumption that they are similarly absorbed from the normal peritoneal and pleural cavities. How far this is true for all such substances we are unable to say, the present status of the lymphatic system being very ill defined.

Absorption from the Normal Peritoneal Cavity in Various Postures.—A priori, it would appear grossly improbable that from over 17,000 sq. cm. of peritoneal serosa of practically uniform structure (an area equal to the cutaneous surface) only a small area representing the central tendon should accomplish even the greater portion of absorption of either fluids or solids. Nevertheless, such is the impression widely prevalent, and it is based principally upon the observations of v. Recklinghausen previously mentioned. Yates tested the absorption of toxins in canines in the horizontal, head-up (30°), and head-down (30°) positions. His work very clearly shows the lethal effect of cobra venum to vary only within narrow limits, regardless of the position assumed, an observation which should demonstrate the fallacy of exclusive diaphragmatic absorption.

FIG. 1.



A composite curve depicting the quantitative absorption of phenolsulphonephthalein from the peritoneal and pleural cavities in canines, in the head-up and head-down positions, over a period of 1 hour, and taken at 10-minute intervals. The head-down position may be taken as representative of the ventral and dorsal positions also.

By utilizing phenolsulphonephthalein and quantitatively estimating the excretion in the various postures, we feel that this impression may with certainty be proven or disproven and its consequent bearing upon the postural treatment of peritonitis definitely demonstrated.

We have injected into the peritoneal cavity of dogs 20 c.c. of isotonic salt solution containing 0.6 mg. of phenolsulphonephthalein and have determined the time of appearance and the quantitative output in the urine, the animal being retained in a given position for a period of one hour.

In estimating absorption in the various postures we have no reason to assume that the parietal serosa absorbs more than its share of fluid. The collargol injections show that fluids are partly detained in the intestinal interspaces so that undoubtedly the visceral peritoneum and the omentum perform a large part of this function, but as to its relative participation it is as yet useless to conjecture. For practical purposes this is immaterial. We are concerned rather with the amount of peritoneal absorption in any given posture assumed in the treatment of peritonitis.

An analysis of these results is as follows:

1. There is very active absorption from the peritoneal cavity in all postures (40–60 per cent. in one hour).

2. The absorption in the head-down (diaphragm)[3] position is practically the same as in the ventral and dorsal positions. Consequently on the basis of absorption there is no evidence of an intraperitoneal current to the diaphragm.

3. The absorption in the pelvis-down position is definitely (15 per cent.) less than in the other three positions. For this fact we have no adequate explanation.

Absorption from the Normal Pleural Cavity in Various Postures.—Experiments of the same kind have been carried out for the pleural cavity. The results are strikingly similar in every way to those obtained in testing absorption from the peritoneal cavity. The appearance time and the quantitative output are practically the same. Very curiously the same dis-

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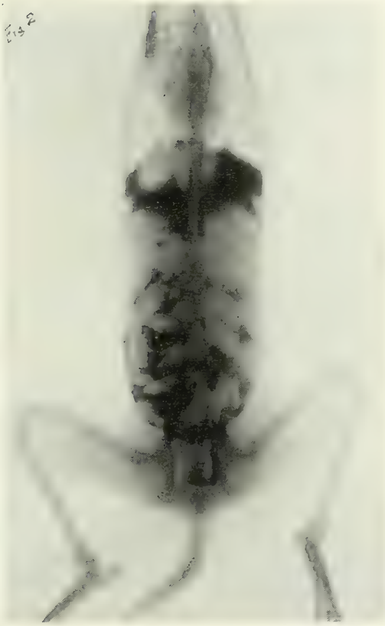
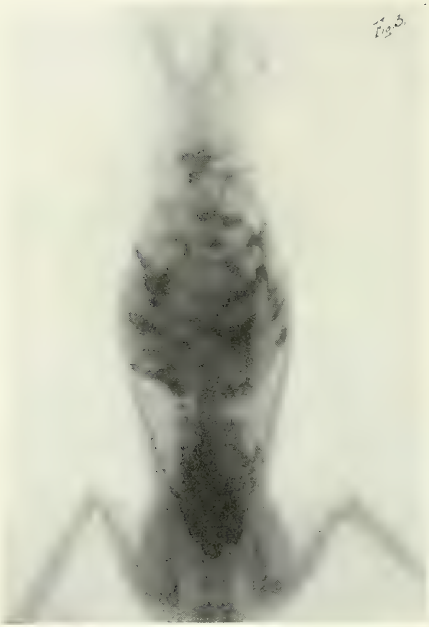
[3] The earlier experiments showed such a parallelism in results in ventral, dorsal and head-down (diaphragm) positions that the diaphragmatic was arbitrarily chosen as representative of all three positions, to contrast with the pelvic which seemed to be definitely low.

FIG. 2.



The effects of gravity on the distribution of intraperitoneal and intrapleural fluids. 20 c.c. collargol injected 15 minutes previously; canine maintained in vertical, head-up, pelvis-down position.

FIG. 3.



Position reversed for 15 minutes after taking X-ray picture (Fig. 2). Now in head-down position 15 minutes. Note shifting of collargol from lower to upper half of abdomen and complete change in pleural fluid, the latter change being practically instantaneous. Also note effect on shape of thorax and abdomen.

crepancy in absorption is present in both the peritoneal and pleural cavities, *i.e.,* absorption is practically equal in all positions except the vertical, head-up position, in which it is definitely less (13 per cent.). We are also at a loss to explain this upon any histological or anatomical grounds.

The Influence of Gravity on Fluids in the Peritoneal and Pleural Cavities.—From the stand-point of operative treatment it is important to know if, by posture, infectious products can be segregated in selected areas where drainage is easier, the environment more propitious, and the subsequent complications of less importance. Naturally the most suitable location from these points of view is the flank or pelvis and the least suitable is the upper abdomen. Opinion is divided as to the effect of gravity on the localization of fluids in the abdomen and thorax.

By injecting collargol into the peritoneal and pleural cavities of dogs and later making an X-ray examination we have been able to observe the effect of gravity on fluids in these cavities. These examinations demonstrate that gravity exerts a very important influence in determining the localization of fluids. In the pleural cavity gravitation is practically instantaneous, in the peritoneal it is slower, its course being retarded and the direction influenced by the intestines. There is no evidence of an intraperitoneal current to the diaphragm.

CONCLUSIONS.

1. There is very active absorption of fluids from all parts of the normal peritoneal and pleural cavities.

2. This absorption is essentially hæmic and not lymphatic.

3. We have quantitatively determined the absorption of fluids in both cavities in the four postures.

4. Peritoneal absorption is practically equal in all postures except pelvis-down, in which it is 15 per cent. less than in the others.

5. Pleural absorption is practically equal in all postures except pelvis-down, in which it is 13 per cent. less. The explanation of these findings we are unable to give.

6. The visceral peritoneum undoubtedly plays an important

part in absorption—probably a more active part than the visceral pleura.

7. We have no evidence to support the view that there is an intraperitoneal current to the diaphragm.

8. There is no evidence in favor of the claims that the central tendon or the diaphragm as a whole performs more than its proportional amount of peritoneal absorption.

9. Gravity has a decided influence upon the localization of fluids—rapid in the pleural cavity, much slower in the peritoneal cavity. The intestines delay and influence the gravitation of fluids in the abdominal cavity.

10. From the above, we conclude that though Fowler's position as originally instituted was based upon entirely fallacious and disproven grounds, there is herewith adduced evidence of a different character, perhaps sufficient to justify the resort at times to this postural method in the treatment of acute diffuse peritonitis. The above results tend also to support the employment of Coffey's lateral modification of Fowler's position.

SUBCUTANEOUS TRAUMATIC RUPTURE OF THE NORMAL SPLEEN.

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By the normal spleen is meant one that is not hypertrophied: from malaria, anæmia, neoplasms.

History.—Aristotle and Paracelsus both speak of the removal of the spleen and say that it is an organ not essential to life. It is an old belief, still prevalent, that the spleen is a hindrance in running. Carstens and Brogsitter mention instances. The latter gives interesting information of the etymology, and the history of splenectomy for rupture. The various derivations are in anatomical, physiological, and psychological senses. Anatomically from λαιὸς, lævus, left side: the French "rate" meaning of irregular, reticular structure. Physiologically from σπλῂν, attracting malignant tumors to itself.

The earliest reported splenectomies were in 1549, by Fioravanti and Zaccarrelli, and another in 1541, both successful. In the next 100 years there were various cases reported, all agreeing that the spleen was not necessary to life. In 1855 there was a great controversy in Germany over the propriety, or advisability, of splenectomy, and as Simon, the then most influential surgical authority, opposed, the operation was abandoned temporarily. Ten years later, however, it was taken up and advocated by Spencer Wells. Most of these early cases were in diseased spleens. Splenectomy for subcutaneous traumatic rupture was advised theoretically by Kücher in 1855, Küchenmeister in 1866, Mayer in 1878, and Nussbaum and Edler in 1877. John Bell classed ruptures of the spleen with wounds of the heart as to their seriousness and dangers; so that anything like successful surgical treatment of these injuries is fairly modern. Before 1874 the mortality of splenectomies was 90 per cent., due to lack of asepsis, faulty technic, and often operating under false indications: such as in cases of leukæmia and amyloid. Recent statistics giving all cases of ruptured spleen in the literature have been published by Bessel-Hagen, Berger, Carstens, Neck, Johnson, Hortz, and Brogsitter (Planson's work, 1909, has not been available).

Neck, in 1905, gives 73 cases of uncomplicated rupture, with a mortality of 37 per cent. Brogsitter, 1909, gives 47 cases of rupture of the normal spleen with these results: splenectomy 64 per cent. well, 35 per cent. dead; tampon 6 cases well; suture 1 case well; suture and tampon 1 case well.

The following case was admitted to my service at the Cambridge Hospital July 8, 1913:

Male, nineteen years, no previous illness. Fell 25 feet from a staging; picked up conscious and brought to accident room. Examination one hour after accident showed spare, muscular boy, with light, sallow complexion; Colles' fracture of left wrist; small abrasions on face and chest; abdomen negative. Pulse 70, temperature and respiration normal. Catheter specimen of urine negative. Complains of pain in left side. Next day: pain in left *lower* abdomen, especially left inguinal region, where muscles are rather tense, and where there is tenderness on pressure extending into the small of the back. Otherwise abdomen and other examinations negative. No signs of fluid in abdomen. No vomiting. Temperature and pulse normal.

Second day: Sudden change for worse this A.M. Vomiting. Severe pain over the whole abdomen; abdominal muscles rigid; tenderness localized low down in left iliac region. *Operation.*—Ether. Diagnosis of probably ruptured intestine, with incision in median line below umbilicus on account of low localization of pain. On entering cavity a gush of dark fluid and clotted blood. Incision packed temporarily with gauze, and second incision made from costal border downward at edge of left rectus. Lower third of spleen found shattered into a pulpy mass, surrounded by blood clots and detached pieces of splenic tissue. In scooping these out with the hand a spleniculus, intact, the size of a walnut, with part of its mesentery attached, was found among the clots.

No free bleeding points seen; profuse general oozing. Three large pieces of gauze packed against wound of spleen pushing it against ribs and diaphragm. As much blood and clots as possible wiped out with gauze, and lower end of wound closed with interrupted through-and-through sutures of silkworm gut. Lower incision closed with small wick to pelvis. Intravenous salt solution; no stimulants. For 24 hours condition critical, then gradual improvement until end of twelfth day when tampons were easily removed. Discharged in good condition at end of sixth week. Blood normal. Five months after injury patient is well with no hernia at splenic wound.

In a search of the literature since the compilation of Brogsitter (1909) I have found reported the following cases of subcutaneous traumatic rupture of normal spleens (in chronological order):

1. ELIOT. Female, thirty-four. Fell 9 ft. Five hours later pulse 132, left side abdomen rigid, dulness left flank, fracture eighth and ninth ribs. Six hours after accident splenectomy. Well 55 days later.

2. LECÈNE. Male, fifty. Squeezed between wall and cart. Two hours later marked contraction of abdominal wall, especially on left, severe pain left hypogastrium with tenderness. Pulse 80. Pale. Splenectomy. Well.

3. FAGGE. Girl, thirteen. Knocked down by motor. Next A.M. abdomen rigid, tender, distended, most marked signs in upper left. No signs of fluid. Restless, pale. No diagnosis. Incision median line, liver explored first. Spleen almost torn in two. Splenectomy. Spleniculus found attached to gastrosplenic mesentery. Discharged in 6 weeks, with no lymphatic enlargements. Five months later well in every way.

4. Ross (not the case in Brogsitter). Male, twenty-one. Fell. Walked home. Pain in epigastrium and left abdomen. Twenty-four hours later severe abdominal pain, rigidity, distention; rapid, weak pulse. Hæmoglobin 48 per cent. Leucocyte count 20,000. No diagnosis. Operation, tampon. Slow recovery.

5. ELIOT. Male, forty-five. Run over. No signs of injury. Temperature and pulse normal. End of third hour pulse up to 100, little pain, no vomiting, no shock. In 5 hours acute pain, with rigidity and dulness in left flank. Incision parallel with costal border. Splenectomy. Well.

6. LUKIS. Male, seven. Run over by van. Abdomen tender, rigid, resonant. Pain in left lumbar region. No signs fluid in abdomen. Too weak for operation. Pulse 140, irregular. Temperature 96, respiration 34, shallow. Eight hours later pulseless. Ten hours later improved. Operation, forty-two hours after admission. Lower third spleen almost separated, laceration near hilus, not bleeding. Splenectomy. Recovery.

7. Corner. Male, nine. Fell down stairs. Vomited once. Shock on admission. Two hours later pulse down from 98 to 86, but boy "looked bad." Area of flatness over splenic region. Splenectomy. Well.

8. Hoffmann. Male, sixteen. Fell, striking left side on iron hoop. Vomited once that night. Next day pale, slightly cyanotic. Pulse 120, abdomen distended and tender on pressure. Dulness in left flank. Diagnosis, ruptured intestine or spleen, more likely former. Median incision. Splenectomy. Well.

9. Hoffmann. Male, eighteen. Kicked by horse in left side. Lips cyanotic. Pulse 110. .Abdomen soft, not tender on pressure. Liver region sensitive. Dulness both flanks. Diagnosis, ruptured liver or spleen. Operation ten hours after accident. Median incision. Three tears in anterior surface of spleen. Suture attempted, splenectomy. Well.

10. Chambers. Male, twenty-five. Run over by light trap with rubber wheels. Severe collapse. Recti rigid, general tenderness, left flank dull not changing with position. Some dulness in right flank. Operation 1 hour later. Splenectomy. Ligature pedicle with needle and catgut. Two hours later signs bleeding. Opened. General oozing from splenic bed. Packed with gauze. Fed bone marrow. Well.

11. Leitner. Boy, twenty. Run over by wagon, jumped on again and rode for half hour; then sudden abdominal pain. Examination 4 hours later; no signs trauma, both recti rigid. Diagnosis, some intestinal injury. Operation, piece of spleen torn off; packed with hot towel; recovery.

12. Viart. Boy, nineteen. Fell 6 ft. Two hours later pale, respirations short and rapid, pulse 110, severe abdominal pain, especially in iliac fossæ. No dulness. Diagnosis, ruptured spleen; refused operation. Ten hours later much weaker, consented. Splenectomy. Well.

13. Vorwerk. Male, nineteen. Splenectomy. Nine and one-half months later, can only do light work; some glandular enlargement; skin and mucous membranes pale.

14. Vorwerk. Male, seventeen. Diagnosis, rupture spleen. Splenectomy 6½ hours after accident; 9 months later fine condition; general glandular enlargement to size of bean. No pallor.

15. Vorwerk. Male, twenty-four. Run over. Diagnosis, rupture of liver or spleen. Median incision; cross incision to liver which was uninjured; cross incision to spleen; splenectomy. No drainage. Three months later looks pale, pain in wound; coagulation time delayed.

16. Mühsam. Male, ten. Run over. Pulseless, white, abdomen shows signs of much free fluid, changing with position. (No other symptoms given.) Diagnosis, rupture of spleen. Splenectomy. End of first week fever with leucocytosis of 80,000. Recovery.

17. Lilienfeld. Male, twenty-one. Fell. Soon after passed blood by urethra. Six hours later pale. Pulse 80, tender in left flank. Tension of upper abdomen; no vomiting. Diagnosis, ruptured spleen or intestine; injury to left kidney. Twelve hours after accident operation; tears in lower pole of spleen; retroperitoneal hæmatoma near left kidney. Splenectomy. No drainage. Rapid recovery.

18. Burnier. Male, seventeen. Squeezed between cart and bus. Pale, weak, pulse 70, few ecchymoses on abdomen. Diagnosis, shock. One hour later sudden change; restless, pulse 140, respiration hurried, temperature sub-normal. Pain on both sides abdomen, more on left; some distention. Diagnosis, internal hemorrhage. Operation 2½ hours after accident; tear at hilus bleeding freely; splenectomy. Died. Autopsy shows nothing. Cause, shock plus operation.

19. Curchod. Male, fourteen. Fell 36 ft. Abdomen very tender, especially in epigastrium; muscular rigidity; no vomiting. Operation 1 hour after accident. Median incision. Transverse tear in anterior border of spleen. Sutured with catgut. Wound closed tight. Convalescence prolonged by lesion, probable fracture of fourth cervical vertebra.

20. Filbry. Male. Run over. Got up himself. Two hours later pain in right clavicle and breast, and lower abdomen. Much distended and tender; liver dulness increased; pulse 76; 6 hours later vomited twice; severe pain in upper abdomen. Diagnosis, rupture liver or spleen. Spleen torn in two. Splenectomy. In splenic bed was a spleniculus. Small tampon to region. Well three weeks later.

21. Jones. Male, thirty-seven. Intoxicated; hit by cab. General abdominal pain; bruises *right* iliac region. Next day signs of internal bleeding, with distention and dulness in right flank. Diagnosis, ruptured liver. Incision right rectus; cross incision to left; splenectomy. Well.

22. Rigollot-Simonnot. Male, thirty-eight. Fell hitting left side on bus; got up and took next one; 15 minutes later pain in abdomen. Fainted. Six hours later cold extremities. Pulse 110, abdomen contracted, very tender; dulness both flanks. Median incision. Splenectomy. Drained. Well.

23. Nast-Kolb. Male, thirty-eight. Kicked in left chest. One hour later, tender swelling left breast, slight muscular rigidity upper abdomen; pulse 84. In evening vomited once. Second day, abdomen soft. Third day, vomited once, pulse and temperature normal. Fourth day, wants to get up; while straining on bed-pan sudden collapse; dulness in splenic region, vomiting. Diagnosis, ruptured spleen. Splenectomy. Died in 4 hours. Autopsy, intense anæmia of all internal organs. No coagula in tears of spleen, no separation of capsule.

24. Charrier and Bardon. Male, eighteen. Run over by wagon wheel. Intense pain in left hypochondrium, very thirsty, no vomiting. Fourteen hours' later, dyspnœa, pale, groaning with severe pain, abdominal muscles tense, especially on left, slight dulness iliac fossæ. Diagnosis, abdominal accident. Operation 16 hours after accident; splenectomy; Discharged 35th day.

25. Strauss. Male, seventeen. Fell 10 ft. In bed 4 days without treatment; pain in left side; sent to hospital in wagon, ¾ hour ride; not admitted; returned 3 days later by foot and tram; pain in left side, flatness up to angle of scapula, otherwise negative; in bed 2 days. On fourteenth day got up, collapsed; vomited, rapid pulse, abdomen distended and tender; by rectum a tender swelling—punctured, gave dark fluid blood. Diag-

nosis, mesenteric embolus. Laparotomy; splenectomy. Very deep tears filled with thrombi. Well.

26. Clarke. Man, fifty-two. Seen two days after fall; pain in epigastrium, some distention, dulness left flank. Exploratory laparotomy; splenectomy. Well. Fed bone marrow and sheep's spleens.

27 and 28. McCoy. Two cases splenectomy following rupture; well 16 and 17 months after.

29. Kahn. Male, eleven. Fist blow left side, 2 hours before entrance. Collapse, with severe pain in *right* hypochondrium. No vomiting. Pulse 126-150, temperature 98.6, respiration 36, marked abdominal rigidity, shock, no dulness on left. Operation 1 hour after admission. Median incision; jagged tear in upper pole of spleen; packed with gauze; removed eighth day. Well.

30. Rait. Male, thirty-two. Blow 3 hours before entrance. Pulse 76, shifting dulness is only marked symptom of abdominal trouble. Grew rapidly worse during preparations for operation. No diagnosis. Median incision; splenectomy. Well. Spleen showed one tear 1 in. long in lower margin; normal size and appearance (Calcutta).

31. Author's case.

This summary includes all the cases reported in this classification from 1909 to November, 1913, except the following, which have not been available, and may or may not be ruptures of the normal spleen: Okinskivich, *Med. Obozr. Msk.*, 1907, lxviii, 889; Oller, *Rev. Spec. Med. Madrid,* 1909, xii, 417-424; Mallett, *Med. rev.,* xvi, 321; Vaccari, *Ann. di med. nav. Roma,* 1909, ii, 533; Kopiloff, *Khir. Mosk.,* xxx, 614; Lindstrom, *Nord. Med. Arch. Stockholm,* 1911, ix, 80; Steinthal, *Med. Cor. Bl. d. würtem. ärtzl.,* 1911, lxxxi, 190; Wille, *Norsk. Mag. f. Laegevidensk,* 1911, 5, R, ix, 722.

Of these 31 cases reported 26 were treated by splenectomy with 2 deaths, a mortality of 7.6 per cent.; Brogsitter's collection showed 34 splenectomies with 12 deaths, a mortality of 35.3 per cent.; progress in surgery or a decline in reporting bad results? Four treated by tampon and one by suture with no deaths. Brogsitter's figures here were respectively 6 and 1 with no deaths.

Etiology.—There are various theories to account for these subcutaneous truamatic ruptures in health. A large percentage of them occur in children, workingmen, and young adults, as naturally they are more exposed to injury. And yet the small percentage (13 per cent. Berger) in men over fifty, with whom falls and blows are usually serious, suggests the possibility that there may be some anatomical or physiological cause of the frequency of this accident in the young.

Nearly half of all subcutaneous ruptures are in diseased, enlarged spleens (Berger), where they may be said to be hyperfunctionating. The frequency of such cases not reported, especially in malarial countries, is shown by a report of Sutherland of judicial autopsies in the district of Saugor (India), where from 1900–1908, of 295 deaths 27 were from ruptured spleens, most of them twice the normal size.

Hoffmann suggests as a cause of rupture in health the greater pliability of the sternum in the young; transmitting the force of the blow, where in the old there is more resistance and fractured ribs result. Berger's theory is hydraulic pressure; comparing the spleen to a vessel full of fluid, which it practically is. Spontaneous ruptures, during pregnancy or confinement, in all of which there has been enlargement, mostly from malaria, and ruptures of enlarged spleens from a very light blow, can hardly be explained otherwise. Johannson quotes the experiments of Petersen, who was unable to rupture normal spleens with a hand pump, while those diseased gave way readily. Brogsitter gives most importance to the splenic ligaments; and supposes a deep inspiration occurring reflexly with the blow. Probably there are factors in all these ideas. To put it as simply as possible: surrounded by the ribs, diaphragm, ligaments more or less tough and always resistant, kidney, pancreas, stomach and intestines often filled with food, is a very friable organ, built like a sponge of connective tissue and a few unstriped muscle fibres, filled with blood, at a pressure of 120–150 mm. of mercury, and covered with a fibrous capsule. The transmitted force of a blow or fall finds it less resistant than its neighbors.

Signs and Symptoms.—Pain is the first symptom; from a blow, more likely to be localized in the splenic region; after a fall, more frequently felt all over the body, or through the entire abdomen. Occasionally the pain is localized in a misleading area, as in my case and that of Rendle, in the left iliac and inguinal region, and Viart's entirely in the lower abdomen. In 4 of Vorwerk's 8 cases there was no localized pain. With more or less rapidity (1 hour—14 days) follow signs of shock or bleeding—it is often impossible to tell which if they appear early, but the pulse remains at first better than the amount of pallor would lead one to expect in shock. In cases of *rapid* bleeding the classic signs of internal hemorrhage are clear enough to establish that diagnosis. The one most important sign is the rigidity and tension of the abdominal wall (though it may occur without any internal lesion). This was emphasized over 100 years ago (Vorwerk cit.) by Baillie, who speaks of a " dureté cylindroide "; also by Vigla in 1844, the " ventre dûr rénitent." With this rigidity is tenderness and spasm on pressure. The rigidity is apt to be diffuse, at first, the tenderness more often localized. Ballance's sign I find to be the least consistent in all the reported cases. It helps if present, but may be obscured by distention with tympany, and blood lodging elsewhere than in the flanks. Pitts and Ballance give as symptoms: 1, Local injury; 2, evidences of local internal hemorrhage; 3, increase of fixed splenic dulness; 4, both flanks dull on percussion, the right flank alone becoming resonant with change of position. The very frequent absence of this last sign needs to be emphasized, because, first, one would theoretically expect it, and, second, because so much importance has been attached to it in the literature. Rieger, Eichel, Notzel, Roser, and West (Brogsitter cit.) all say that there is usually no increase in splenic dulness. Brogsitter makes a point of the absence of vomiting; and the reported histories seem to bear out the importance of this observation. There was vomiting mentioned in only 6 of the 31 cases collected here; in my case there was no vomiting until the second day; in one case it came on early; once at 8 hours; once at 12 hours; once not till the fourteenth day. Rohrbach, on the other hand, would count absence of vomiting in favor of contusion rather than rupture. Vomiting means a serious injury, but its absence, together with abdominal muscular rigidity, favors a rupture of the spleen rather than a ruptured stomach or intestine. Levy and Shulze speak of pain radiating to the left shoulder, but it is seldom mentioned in reported cases.

It is surprising how little attention has been paid to the leucocyte count as an aid in the diagnosis. I recollect only one case (No. 4) in all those I have read over where it was mentioned (before operation). In my case no count was made until the appearance of severe symptoms on the second day, when it was found to be 30,000. Theoretically one would expect a steadily rising leucocytosis after the injury.

Diagnosis.—An accurate diagnosis is rarely possible. The history of an abdominal blow or a fall, followed by tension of the abdominal muscles and the beginning of the signs of hemorrhage, should be enough for an exploratory incision; preferably under local anæsthesia as recommended by Trendelenburg, Mickulicz, Pauchet, Georgi, Petzow, Krabbel, Simpson, Notzel (Rohrbach cit.). Lemerenz in 30 cases found that an accurate diagnosis had been made in 5, and in the 31 cases here it is mentioned as made correctly in 4. A diagnosis of ruptured liver or spleen is frequent.

Treatment.—The mortality in unoperated cases is 94 per cent. in normal spleens, and 90 per cent. in those diseased; average 92 per cent. (Berger). There are a few records of cases at autopsy showing old tears healed by clots, and there are two specimens showing this in St. Bartholomew's Hospital museum (Lukis). The three commonest methods of treatment in order of frequency have been: 1, Splenectomy; 2, tampon; 3, suture. The statistics of results are *all* splenectomies to 1890, 42 per cent. mortality; 1891–1900, 18.9 per cent. mortality (Bessel-Hagen). Brogsitter (1909) in all reported cases of traumatic rupture of *normal* spleens finds 35 per cent. mortality; and the cases since 1909 collected here give 6.4 per cent.

Other methods of treatment such as ligature of the splenic vessels, magnesium wire, cautery, steam, and hot air have been tried and need only be mentioned here. Senn's method of crushing the edges of the splenic wound with forceps, and then suturing, was successful in dogs, but any kind of suturing of the human spleen is too difficult and too uncertain, notwithstanding the success of Curchod in case No. 19 here. Sheldon, in dogs, clamped the splenic vessels for 4 hours, letting the blood in the spleen drain out, avoiding tampon and consequent thrombosis of vessels in the spleen. At the end of this time the clamps were removed and there was no bleeding. The dogs killed from 1–3 weeks later showed spleens with good circulation and no areas of necrosis. So far as I know this has not been tried in man.

Splenectomy has been the prevailing treatment, and the only one advocated by most of the writers, until Brogsitter, who realizes the value and possibilities of tamponade. This method has found more favor with American and English surgeons (4 of Brogsitter's 6 cases, and all 4 of my cases). In injuries involving the hilus of the organ, where large vessels are torn, I believe that splenectomy is still indicated.

Otherwise tamponade is the "ideal treatment," if by "ideal" we mean the method offering the best chances for a living and organically intact patient. From the point of view of surgical technic only is splenectomy the ideal form of treatment. My reasons for this view are:

1. The statistics of tamponade, admittedly few but nevertheless reassuring, are: Berger 6 cases, 1 death; Brogsitter 6 cases, no deaths; cases here 4, no deaths. A total of one death in all of the 16 cases reported to date. (A case of Brewster, omitted by Brogsitter apparently, recovered with tampon.)

2. Increased danger to the patient of adding the shock of splenectomy to the shock of his injury. The nerve supply is abundant; from the splanchnic nerves and cœlic ganglia. Tamponade is quicker.

3. Structurally and geographically the spleen is well suited to treatment of hemorrhage by tampon. With a good exposure of the operative field all tears can be felt and there need be no danger of bleeding posteriorly into the lesser cavity.

4. The possibility of lessening the motility of the stomach or colon from adhesions is not a serious contra-indication—witness the various operations such as Rovsing's.

5. The economical value of the spleen in our physiology. In spite of the cases which have lived in reported health for years without the organ—Pean's 13 years, Vulpius's 15 years, Adelmann's 23 years (Vorwerk's cit.)—the more work that is done in the physiology of the spleen the more evident it becomes that it is not an organ to be sacrificed for a few tears if the hemorrhage can be stopped in some other way. (See present work of Vogel, Asher, and Pearce.) All splenectomies show a hæmoglobin of about 70 per cent., and the presence of transitional forms of blood cells for a varying length of time; signs of a serious disturbance. Compensation is often established so slowly that patients are invalids for the first year at least. Tamponade gives a more rapid convalescence. Only a small proportion of splenectomies have been followed with sufficient care for any number of years, and experimental work has been conflicting and contradictory. Kanavel concludes from his work on dogs that non-union of fractures cannot be attributed to loss of the spleen, but in splenectomized men repair has been long delayed. Hubbard worked with guinea pigs and concluded that there was no diminution of resistance to infection from splenectomy. He reports a case of his own perfectly well three and three-quarters years after operation, and reacting normally to a quinsy throat. But other experimenters have obtained conflicting results, as shown by Danielson. What the spleen does with iron we do not know definitely; we do know that after splenectomy the formation of bile pigments is interfered with and their amount reduced; and that less trypsogen is secreted by the pancreas. A point to be remembered is that the function of the spleen varies much in different species, and one must be careful in assuming that experimental results in animals will hold good for man. There is no proof yet that splenectomy in man makes him peculiarly susceptible to infections. But one cannot help feeling in studying reported cases that many spleens have been sacrificed by

splenectomy where tamponade would have stopped the bleeding.

Technic.—A median incision under local anæsthesia is the best, as the diagnosis is usually uncertain. From the upper end of this incision a cross incision, following the border of the ribs, gives a good field for determining the extent of the injury, and for splenectomy should it be necessary. Resection of the lower rib cartilages has been recommended by Auvray, Lejars, Lötsch, Rabinowitch, and Kocher (Brogsitter cit.), but it is probably not necessary unless the spleen is enlarged. The definite contra-indication to splenectomy is leukæmia or pseudoleukæmia.

Conclusions.—In the diagnosis, local abdominal signs (the results of hemorrhage) are seen earlier than the general signs of hemorrhage. The leucocyte count should be watched carefully in the absence of other definite signs. Make an early exploratory abdominal incision under local anæsthesia when suspicious signs and symptoms follow an injury or fall. The spleen may be ruptured with remarkably few evidences of it. Preserve the spleen if it is possible to tampon the injured area.

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HERNIA OF THE LARGE INTESTINE.*

WITH SPECIAL REFERENCE TO "SLIDING HERNIA."

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ALTHOUGH first described by Scarpa, this variety of hernia did not receive much attention until the French surgeons began to study the subject. The German articles are few and far between, although an excellent article on the subject has been written by Sprengel (*Archiv f. klinische Chirurgie,* vol. 95, page 702). In this country Weir (*Medical Record,* February 24, 1900) gave the subject an excellent résumé, and published cases of his own.

Judging by a personal experience, this form of hernia is of more frequent occurrence than one would be led to assume by the number of cases reported. This can be accounted for in two ways; either the hernia has not excited sufficient interest in the operator, or (which in the writer's opinion is more likely) the operator did not wish to be reminded of a rather unpleasant experience.

The operation for the radical cure of a hernia of the large intestine may be one of exceptional difficulty; it is important, therefore, that the surgeon bears the possibility of its presence constantly in mind. He must, in addition, be well acquainted with all the forms and possibilities of such a hernia, inasmuch as considerable, and often irreparable damage may be done.

The five divisions of the large intestine, viz., cæcum, ascending, transverse and descending colons and the sigmoid flexure, all have their peculiarities when met with in a hernia; it is necessary, therefore, to discuss each division separately.

Before proceeding to the individual description of these subvarieties, it is necessary to call attention to a phenomenon peculiar to herniæ of certain portions of the large intestine.

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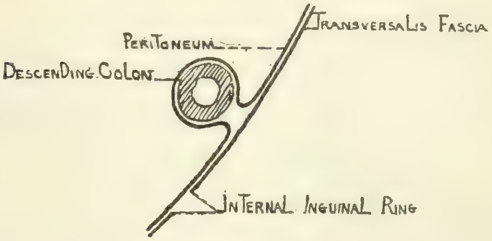
* Read before the New York Surgical Society, Dec. 10, 1913.

This phenomenon has been called by the French "hernie par glissement," or translated into English, "sliding hernia."

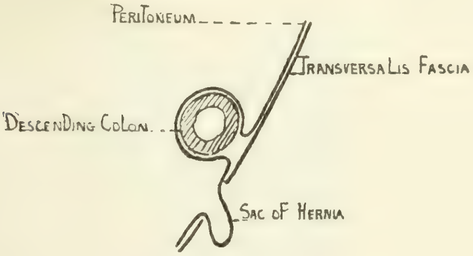
It is difficult to give a short description of this phenomenon; but a clear mental picture of this hernia can be obtained in the following manner. Let us imagine, for instance, that the peritoneal attachments of the descending colon have become loosened from the subjacent structures, so that the colon, instead of being a fairly fixed structure, now moves easily in its bed; let us then imagine, that the peritoneum in the neighborhood of the internal inguinal ring is grasped, and then pulled in the direction of the scrotum. What will happen under these circumstances? First, a hernial sac is being pulled out, and eventually the sigmoid flexure and descending colon. The successive steps of this procedure are illustrated in Figs. 1–5.

FIG. 1.



Sliding hernia of descending colon by "pulling" mechanism. First stage.

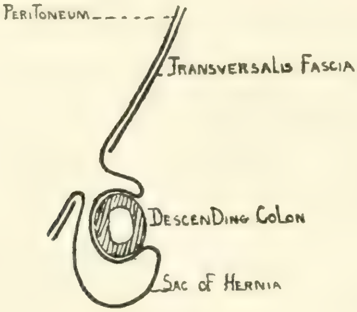
FIG. 2.



Sliding hernia of descending colon by "pulling" mechanism. Second stage.

The sigmoid flexure, being covered on all sides by peritoneum, does not necessarily differ from a loop of small intestine, but the descending colon is usually covered only on three sides by peritoneum; it is evident, therefore, that after being pulled down, the descending colon will form part of the posterior surface of the sac. This is one variety of sliding hernia, and may be termed a "sliding hernia by pulling."

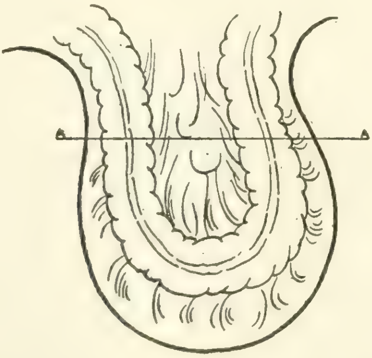
FIG. 3.



Sliding hernia of descending colon by "pulling" mechanism. Third stage.

Let us now imagine the following. For the purpose of our experiment, the descending colon has again been loosened, as in the preceding assumption. Let us now suppose that pressure or force has been applied over the descending colon, just above its junction with the sigmoid flexure; the direction of this

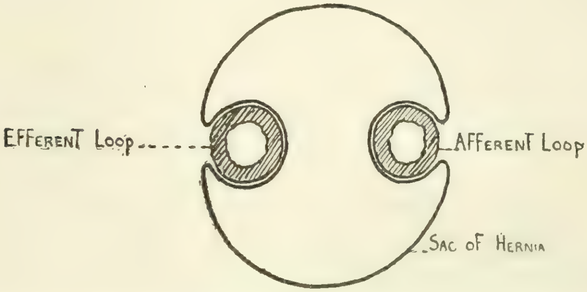
FIG. 4.



Sliding hernia of descending colon by "pulling" mechanism.

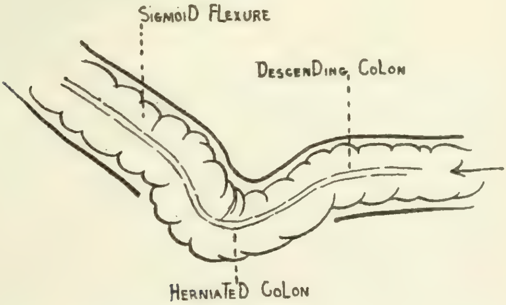
force must be first backward, then downward and inward, toward the internal inguinal ring. What happens under these circumstances? First, the anterior wall of the descending colon is approximated to the posterior wall; the force continuing against the posterior wall, this segment of the descending colon is pushed nearer and nearer to the internal inguinal ring, until finally it is pushed out behind the peritoneum into the inguinal canal (Fig. 6). We now have a true hernia without any involvement of the peritoneum, *i.e.,* a sacless hernia. In contradistinction to the first variety this may be termed a " sliding hernia by pushing."

FIG. 5.



Diagrammatic cross-section of sliding hernia of descending colon by "pulling" mechanism. Section made at *AA* in Fig. 4.

FIG. 6.



Sliding hernia of descending colon by "pushing" mechanism; so-called sacless hernia.

Both of these herniæ occur with about equal frequency. There are certain differences between the two, with which it is well to be acquainted. Herniæ by pulling are usually very large; herniæ by pushing are very small. Herniæ by pulling usually have a very large sac; herniæ by pushing usually have no sac at all. In the herniæ by pulling, the nutrient vessels of the gut are usually pulled down with the gut; in the herniæ by pushing, the nutrient vessels need not necessarily be in the hernia.

If this pathogenesis is borne in mind, it becomes evident that only those parts of the large intestine can be involved in a sliding hernia, which are not covered on all sides by peritoneum. It is manifest, therefore, in spite of assertions to the contrary, that the ascending and descending colon are the only parts of the large intestine that can enter into the composition of a sliding hernia. Most authors speak of the sigmoid flexure as the sliding organ, but this is manifestly incorrect.

Before making a statement so radically different from the conventional view, it is necessary to define precisely what part of the large intestine is meant when we say " sigmoid flexure." Unfortunately even anatomists are not agreed, and call this part of the intestine by different names, such as sigmoid flexure, S. romanum, iliac colon, pelvic colon, S. iliac, etc., etc. The writer prefers to adhere to the orthodox nomenclature according to which the sigmoid flexure is that part of the large intestine, which has throughout its entire extent a well-defined mesentery, the mesosigma; in contra-distinction to the descending colon, which is covered only on three sides by peritoneum.

However, the distinction as to whether an organ is completely or incompletely covered by peritoneum is a very narrow one. Broadly speaking, there is no organ which is completely surrounded by peritoneum. All the organs are in fact extraperitoneal, being merely tucked to a greater or lesser extent into a closed peritoneal sac. It also follows, therefore, that almost every organ under favorable conditions may become the sliding part of the sliding hernia. Thus, for instance, we speak of the small intestine as having a complete peritoneal investment; yet in very large herniæ upon the right side, in which the cæcum and ascending colon are pulled down, so much of the mesentery of the small intestine may become unfolded and enter into the formation of the huge sac, that even the small intestine may appear as a sliding hernia. Similarly upon the left side, while we speak of the sigmoid flexure as having a complete peritoneal investment, the sac may be so large, that the mesosigmoid becomes unfolded, and the sigmoid flexure itself may become the sliding part. But these are rare instances; the writer has never seen the sigmoid flexure as a sliding hernia, but has seen a case of sliding hernia of the small intestine in which the hernia reached way below the knee. On the other hand, the broader the uncovered area of a viscus, the greater is the likelihood of this viscus being found to be the sliding part of a sliding hernia.

On theoretical grounds we may, therefore, divide the abdominal organs, according to their likelihood of entering into the formation of a sliding hernia, into the following groups:

Always.	Never.	Rarely.	Likely.
ureter	ovary	sigmoid flexure	ascending colon
	stomach	small intestine	descending colon
	liver	uterus	broad ligament
	spleen	Fallopian tube	bladder
	transverse colon		appendix
	cæcum		
	omentum		

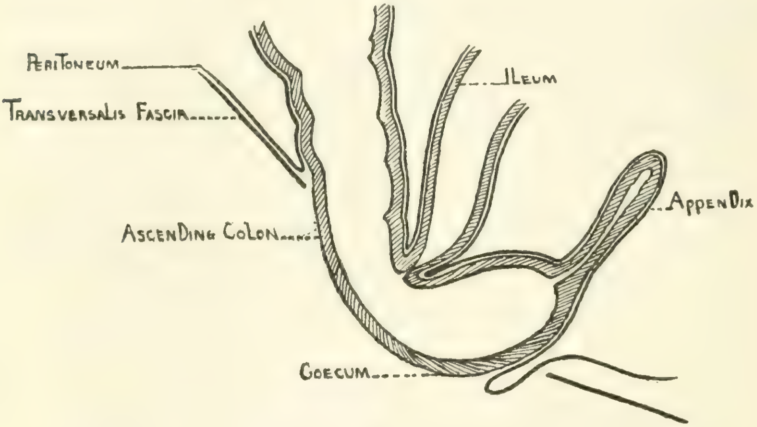
Finally, the writer wishes to state, that by the above description he only refers to the sliding organ, which has nothing to do with the hernia. In other words, we may have combinations; thus, for instance, there is nothing to prevent the ovary from being in a sliding hernia of the descending colon; in such a hernia, the ovary is merely an accidental content of the hernia, but the sliding part is the descending colon only.

Assuming the correctness of the pathogenesis of sliding hernia that we have set forth, it becomes self-evident that the terms "hernia of the large intestine" and "sliding hernia," are by no means synonymous. This mistake is only too frequently made in medical literature.

All herniæ of the large intestine, whether sliding or not, have certain other peculiarities, according to the organ prolapsed.

a. Hernia of the Cæcum.—Anatomists have described various forms of the cæcum. For our purpose it is sufficient to say, that the cæcum is that part of the large intestine which lies below the ileocæcal valve. Its blood supply comes from above and from the median area of the abdomen; it is, therefore, an organ which has a complete peritoneal investment. The cæcum can, therefore, never be the sliding part of a sliding hernia. It is merely prolapsed into the hernial sac, and can always be reduced with the greatest ease.

FIG. 7.



"Hernie par bascule."

When, however, it is found in combination with sliding herniæ of the ascending colon and adjoining portions of the small intestine, then its reduction may not be easy. One form of such a hernia is particularly puzzling, so much so, that the French have seen fit to give it a special name "hernie per bascule."

The pathogenesis of this hernia is the following: Let us assume a very small sliding hernia of the posterior wall of the ascending colon, at the point where this organ joins the cæcum. In the progress of the hernia more and more of the adjoining portion of the cæcum is being extruded, but a small part still remains within the peritoneal cavity (Fig. 7). We have then a small sliding hernia of the lowermost part of the posterior wall of the ascending colon; a small intrahernial part of the cæcum; and a small intra-abdominal part of the cæcum. It is as though the cæcum was partly bent upon itself, like a hammock. This is the so-called " hernie par bascule."

b. Hernia of the Ascending Colon.—It has already been noted that the ascending colon occurs in an inguinal hernia only in the form of a sliding hernia (exception of course must be made for those isolated cases, in which the ascending colon has a complete mesentery). Furthermore, that it may occur in two different forms: first, in large herniæ, the pathogenesis of which is explained by a "pulling" mechanism; in this case the ascending colon is frequently accompanied by other viscera in the vicinity of the internal inguinal ring, viz., the cæcum, appendix, small intestine and omentum. And second, in small herniæ, the pathogenesis of which may be explained by a "pushing" mechanism; this second form may be entirely devoid of a sac, and may in consequence be very baffling. It is true, there may be a very minute sac toward the mesial side of the gut, but this is expected owing to the dislocation of the intestine.

c. Hernia of the Transverse Colon.—The transverse colon for practical purposes has a complete peritoneal investment; it is, therefore, never the sliding portion of a sliding hernia. In any event, it is a rare hernial content, and then only in those of extreme size, and when the organ is prolapsed. Being completely invested by peritoneum, its reduction never causes any difficulty.

d. Hernia of the Descending Colon.—With negligible modifications the remarks on herniæ of the ascending colon apply equally to those of the descending colon.

e. Hernia of the Sigmoid Flexure.—Most of the special articles on sliding hernia speak of herniæ of the sigmoid flexure as a type example of sliding hernia. The reasons why the sigmoid flexure, except under unusual conditions, cannot form the sliding part of a sliding hernia have already been discussed.

Treatment.—The treatment of uncomplicated herniæ of the cæcum, transverse colon, and sigmoid flexure, is no different from any other simple form of inguinal hernia.

The treatment of sliding hernia, however, *i.e.,* the treatment of herniæ of the ascending or descending colon is an entirely different proposition. There is hardly any operation that may tax the patience and technic of the best equipped surgeon more.

a. Sliding Herniæ by a "Pushing" Mechanism.—These herniæ are usually of small size. Exposure is usually very easy through the usual hernia incision. A not uncommon description of such an operation is the following. The first thing that strikes the surgeon is, that search as he may for a sac at the usual site, *i.e.*, toward the inner side of the cord, no sac is found; again and again he repeats this manœuvre, and again and again he fails. At this point he begins to doubt even the diagnosis of a hernia; perhaps the patient now reacts slightly from the anæsthetic, and coughs or vomits; and sure enough he sees a distinct hernial bulging, and so he begins all over again, with the same result. The patient again vomits or strains, and then he notices that the hernia does not come down on the inner side of the cord, but to the outer side and posteriorly. Even at this stage it is fortunate, if he recognizes by this sign, that he is dealing with a sacless sliding hernia. The surgeon who fails to recognize what he is dealing with, sure only of the presence of a hernia, boldly incises what he believes to be the sac; meets hemorrhage, the importance of which he does not appreciate, and to his chagrin, finds himself within the lumen of the gut. This graphic description need not be considered overdrawn; it occurs frequently.

The most important step in the treatment of these herniæ is their recognition. These herniæ are so small, that they can be readily pushed back, with a little blunt dissection, not into the peritoneal cavity, but into the retroperitoneal space. It is not even necessary to open the peritoneum; at most the peritoneum at the inner side of the internal inguinal ring may be incised, in order to verify the correctness of the diagnosis; the small incision can be immediately closed by a purse-string suture.

Deep sutures are passed, care being taken that the gut is held replaced during the process of tying.

b. Sliding Hernia by a "Pulling" Mechanism.—In contradistinction to the preceding variety, these herniæ are usually of large size.

A picture of the operation for such a hernia is often the following. Being of large size, the sac is easily found and incised. Various hernial contents are found, but most of them are readily replaced; but there still remains a piece of intestine, which resists all our efforts at reduction. There is more pulling, more pushing, and more violence, but this piece of intestine refuses to budge. The sac is then incised more widely, and fortunate is both the patient and the surgeon, who even now recognizes that he is dealing with a sliding hernia of the large intestine. The operator who misses this recognition, regards the intestine as adherent, and proceeds to liberate it; he divides the peritoneum on one or the other side of the intestine; soon considerable hemorrhage is encountered, which is interpreted as coming from vascular adhesions. What has really happened is, that the vascular supply of the prolapsed gut is being cut off. After sufficient gut is liberated, a finger is passed into the peritoneal cavity; the continuation of the gut is felt, and is interpreted as the continuation of the adhesions. If the liberation of the intestine is further proceeded with, the lumen of the gut may be entered. The gut is finally reduced in a slipshod manner, and the sac tied off in an equally slipshod manner. If only a small piece of the intestine has been thus deprived of its arterial supply, the anastomotic circulation may be sufficient to restore vitality; if, however, a large piece of the gut has thus been deprived of its arterial supply, or if the ligatures were placed too close to the gut, beyond the last anastomotic arches, gangrene may result, and the patient dies from a perforative peritonitis.

The surgeon who knows proceeds differently. When he finds that there is difficulty in reducing the last piece of intestine, he incises the sac more liberally, inspects this piece of intestine, and finds here and there upon its surface small pieces of fat, which he recognizes as epiploic appendages; further inspection will also reveal to him upon the surface of the gut, at least one longitudinal band; both points absolutely indicative of large intestine. He does not look upon it as an adherent loop of intestine, but correctly diagnosticates it as a sliding hernia of the large intestine and proceeds to treat it as such, in the following manner. The method was first suggested by Hotchkiss (ANNALS OF SURGERY, vol. 50, page 470) and amplified by Walton (ANNALS OF SURGERY, vol. 57, page 86).

Assuming that the incision of the sac was properly made in the centre of its anterior surface, the incision is then extended the full length of the sac. Its liberation is proceeded with cautiously; first the spermatic cord is encountered and dissected away; the liberation proceeds further and further (and is quite easy, if it has been started in the proper line of cleavage), until the hernial sac, the herniated intestine, plus its blood-vessels, are lifted up from the posterior wall of the hernial space. None of the blood-vessels should ever be injured, if this dissection is properly done. The sac is thus liberated on both sides, but far more freely on the outer side.

The intestine and sac are now held up perpendicularly, when it will be seen, that on both sides of the intestine the sac drops down over the nutrient vessels; the sac is now fastened here and there by an interrupted stitch; when this is done, it is seen that we have made a sort of an artificial mesentery for the intestine. If the liberation of the intestine and vessels has been properly done, there should be no further trouble in reducing the intestine. The remainder of the sac is now closed by a running suture, as a ligation is evidently an impossibility. The radical operation of the hernia is now proceeded with in the usual manner. Throughout the operation it must always be borne in mind that the vessels enter from the mesial side of the gut; particular care is therefore necessary not to injure them.

In one case the writer attempted the following procedure for the cure of a sliding hernia, after the diagnosis of a sliding hernia by the " pulling " mechanism had been established. The inguinal incision was temporarily packed with gauze. A separate abdominal incision was made; in the Trendelenburg position the colon was now pulled back into the abdomen, and fastened to the posterior abdominal parietes, by sufficient interrupted stitches of silk (colopexy). After closure of the abdominal incision, the redundant part of the hernial sac was freed and extirpated, and the radical part of the operation finished in the usual manner. The writer has since learned that the Lardonnois had previously suggested a similar procedure.

LOOPING THE CARDINAL LIGAMENTS IN UTERINE PROLAPSE.*

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THE multiplicity of operative procedures for prolapsus uteri indicates to some extent the uncertainty of opinion as to the essential cause of the condition. Could this be placed upon a completely satisfactory basis, the surgical treatment of uterine prolapse should at once become direct and definite. Assuming, as we obviously must, that the supports of the uterus have in some way been injured to permit of its downward displacement, the surgical treatment should take the form of a complete or approximate restoration of the injured parts to their normal state. If so much be granted, we must, in any attempt to evolve a rational surgical treatment, proceed to discover, if possible, what actually are the supports of the uterus.

A study of the literature of the subject reveals that the pelvic diaphragm is commonly regarded as the principal support of the uterus, and that the ligaments are considered of secondary value as supports of the organ, one writer going to the length of referring to the theory, that the ligaments are the primary supports, as being " antiquated." As opposed to this latter attitude Emmet long ago drew attention to the fact that the pelvic diaphragm might be lacerated up to the bowel without indication of downward displacement of the uterus, even in the presence of strenuous physical work. And I can recall a case in the Perth Hospital in which, in spite of some incontinence of fæces due to an old perineal laceration extending into the sphincter ani, there was not the slightest indication of uterine prolapse, although the patient was accustomed to do a big washing once a week. In this case, too, even when the vagina was widely opened up by a broad posterior speculum, the uterus could be drawn down with a vulsellum no further than in the normal female, and at once retracted on relaxing the vulsellum. These facts suggest that although the pelvic diaphragm may be an important element in supporting the uterus in the pelvis, it may not have that primary influence many would have us believe. It is to be noted in this connection that some surgeons, who in their theories treat the uterine ligaments with scant courtesy as supports, yet do not hesitate to make use of those ligaments as an important part of their operative procedure for uterine prolapse. Thus, it is not uncommon for them to recommend the curtailment of the round and uterosacral ligaments. It would doubtless be urged that the object of shortening these anterior and posterior ligaments was largely, if not entirely, to cause the uterus to rest upon the bladder in its normal position of anteversion, and thus place it at an advantage as far as the influence of intra-abdominal pressure is concerned. And, although to some extent this explanation would be valid, it would, I think, be a closer approximation to the truth to say that these tightened-up ligaments *support* the uterus in its newly-restored anteverted position, and thus encourage the lateral ligaments of the uterus (cardinal ligaments) to gradually contract and strengthen by physiological rest.

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* Read at the Australasian Medical Congress, Auckland, New Zealand, February 13, 1914.

In what might, for convenience, be termed the English school of treatment of prolapsus uteri the round ligaments are curtailed, or some form of hysteropexy carried out, with perhaps a curtailment of the uterosacral ligaments, followed or preceded by some form of colpoperineorrhaphy. The American school long ago attacked by the vaginal route the tissues in the broad ligaments—elytrorrhaphy—a procedure which has been elaborated by Reynolds, Hertzler, and others with some degree of success. And some of our Continental brethren have turned the uterus nearly upside down, or otherwise put it into unnatural positions, or have carried out elaborate procedures on the vagina. By all these various measures more or less satisfactory results have been claimed. But in contemplating this bare outline of the multitudinous operations which have been advocated, one cannot but realize that they cannot *all* be founded on the only rational basis of treatment—seeking out the essential cause and directly attacking it.

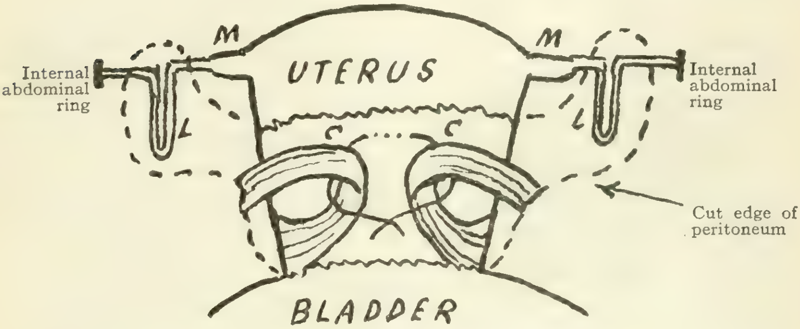
The only operative procedure for uterine prolapse which seems to me to bear the light of rigid investigation is that which directly deals with certain tissues (in the broad ligaments) passing out from the sides of the uterus. These structures—the cardinal ligaments—I have no doubt whatever are the main element holding the uterus at a more or less definite level in the pelvis. Their supporting power is illustrated in vaginal hysterectomy (in a normally-fixed uterus), when all supporting elements except the broad ligaments have been completely severed. At this stage in the hysterectomy the uterus can only be drawn down by a vulsellum in the cervix exercising some force, the resistance to this force being the pull of the cardinal ligaments on the uterus. When the vulsellum is released, the cardinal ligaments, pulling on the uterus, draw it back to its original position.

The cardinal ligaments can be readily demonstrated in the abdomen of the dead subject by turning the bladder down from the uterus. They commonly arise by three more or less definite heads from each side of the uterus, the middle head corresponding to the position of the uterine artery, the interior head being attached to the upper surface of the lateral vaginal fornix, and the superior head being attached a little above the median head. G. Reynolds and E. C. Dudley lay stress on the important part the vaginal attachment of the tissues in the broad ligament plays in holding up the vagina, bladder and rectum. Thus, according to Dudley, " . . . the fact that vaginal hysterectomy commonly results in holding up the pelvic floor, and with it the rectum, vagina, and bladder, is because the broad ligaments are fixed in the vaginal wound." The three heads of the cardinal ligament unite together to form a band about half an inch or more in width, which passes outward for over an inch between the layers of the broad ligament. The cardinal ligament, which up to this is largely muscular, now tends to change its character, sending off fibrous bands, fanwise, to the wall of the pelvis and other parts, some of these bands, it is to be noted, being inverted into the posterolateral wall of the bladder and others passing up over the iliacs. After locating the ureter, the cardinal ligament may be dissected from the posterior peritoneal layer of the broad ligament, and thus completely isolated. Hooking the ligament up on the finger it is found to be elastic, and of considerable strength, and obviously quite capable of adequately supporting the uterus in the pelvis. For his valuable help in the final dissections, before completing this paper, I have to thank Dr. C. Kellaway, Registrar to the Melbourne Hospital.

During a recent visit to Melbourne I was enabled to make further dissections verifying those already made in Perth, although much still remains to be done in connection with the cardinal ligaments. However, in spite of the comparative limitations in this regard in Perth I felt justified, in papers to the Australasian Medical Congresses of 1908 and 1911, in laying down certain premises which appear satisfactory as working propositions. In the second paper I sketched out my present operation of looping the cardinal ligaments. The propositions referred to are: (1) that the uterus is sustained in its normal position in the pelvis by its ligaments, although capable of a certain range of movement on account of the elasticity of these ligaments; and (2) that the pelvic diaphragm prevents undue stretching (*i.e.,* strain) of the ligaments as the result of intra-abdominal pressure. In accordance with these propositions the primary supports of the uterus are its ligaments, while the secondary support is the pelvic diaphragm. If we accept these propositions as true, and believe that the cardinal ligaments are the main element holding the uterus at a more or less definite level in the pelvis the causation and treatment of prolapsus uteri become comparatively simple. The treatment will be primarily directed to the ligaments, and above all to the cardinal ligaments, and secondarily to the pelvic diaphragm. The following cases, operated on in the Perth Hospital, illustrate these principles of treatment.

Case I.—Mrs. B., forty-eight years, 10 children, youngest twelve years, irregular menstruation. The cervix projected over an inch outside the vulva on standing, and required to be shoved back to permit of sitting; it was lacerated and hypertrophied, while the external os and surrounding area was red and eroded. The cervix first protruded over two years earlier. There was marked cystocele as well as some rectocele, with diastasis of the levatores ani from an old perineal laceration. Suprapubic abdominal cœliotomy was performed on July 9, 1913. The bladder was thrown down from the uterus after breaking down adhesions of the bladder right up to the fundus uteri. In then separating the bladder from the uterus an adventitious cyst with smooth lining and about two inches broad was opened into. The attempt to dissect it off the uterus was partially abandoned because of free hemorrhage. The cardinal ligaments being then exposed were dissected off the posterior layer of the broad ligament, and looped up on the anterior wall of the uterus, to which they were sutured with silk. After taking a loop in each round ligament, the wound in the peritoneum was closed with a continuous catgut suture. The utero-sacral ligaments were so attenuated by stretching that they could not be certainly identified. On attempting to " manufacture " them by stitching the posterolateral margin of the uterus to the peritoneum lateral to the rectum, the stitches tore out on account of the friability of the peritoneum in an obese person. The patient did well after operation, a striking feature being that in this case as in subsequent ones there was practically no post-operative shock. Three weeks later large wedges were re-

Fig. 1.



The cardinal ligaments (*c, c*) are looped on to the anterior uterine surface, the utero-vesical pouch having been opened and the bladder thrown down from the uterus. The loops (*L, L*) in the round ligaments correct retroversion, the internal muscular parts (*M, M*) of the ligaments being encroached upon as little as possible.

moved from the hypertrophied cervix, a procedure which proved difficult from the impossibility of drawing the uterus far down the vagina without using undue force. At the same sitting, anterior colporrhaphy, and colpoperineorrhaphy were carried out. The final result was all that could be desired, the uterus being normal in size, fixed well up in the pelvis in its normal anteverted position, and the patient feeling unusually well. Recently I saw her looking splendid, menstruating regularly, and about to set out to confine her daughter.

Case II.—Mrs. W., forty years, 3 children (youngest three months). Procident uterus for last 2 years, reaches vulva after exertion. Lacerated perineum (unrepaired) at first confinement 4 years ago. The abdomen was opened, after curettage, on September 10, 1913. Looping of the cardinal ligaments and of the round was carried out as in Case I, thus placing the uterus in its normal position in the pelvis. Finally, there was nothing to show that an operation had been performed in the abdomen except a two-inch suture line in the uterovesical fold of peritoneum, and this could only be seen when the fundus uteri was pulled backward. A fortnight later the diastasis of the levatores ani was remedied by a perineorrhaphy, and the patient left hospital restored to a normal condition as far as examination could show.

Case III.—Mrs. R., forty-six years, 10 children (youngest seven years), some metrorrhagia. For the last two years the cervix uteri has projected for about an inch after any physical exertion. It was much hypertrophied, and there was erosion around the external os. There was cystocele and rectocele, with marked diastasis of the levatores ani, the muscles having retracted almost to the bones. The uterus was a good deal enlarged, heavy, and congested, and by the abdomen was found to be œdematous. The patient looked much older than her age, was edentulous, flabby and nervous, the first heart-sound at the apex was weak, and the aortic second sound accentuated. On October 27, 1913, after curettage and removal of wedges from the cervix, the abdomen was opened and looping of the cardinal and round ligaments carried out, the uterus being thus restored to its normal position in the pelvis. The patient's condition caused anxiety to the anæsthetist, so that she was never completely under the "open ether" administered, thus rendering the operation very difficult and unduly prolonged. In spite of this the patient showed practically no evidence of post-operative shock, and made little complaint of pain. In this and Case II the upper free margins of the superior heads of the cardinals were beautifully defined. Some weeks later the cystocele was found to have greatly diminished, so that only the diastasis of the levatores ani was dealt with, and finally, the patient left hospital completely restored.

Case IV hardly calls for description as it is merely a repetition of the remarkable success of the other cases.

Case V.—Mrs. C. W., twenty-nine years, married 5 years, 3 children (last aged nine months), no miscarriages, menorrhagia. She complained of the uterus "coming outside" for the last 8 months. On examination the cervix uteri was found markedly hypertrophied, ulcerated from friction, and cutaneous from long exposure to the external air. With a very trifling pull a vulsellum drew the cervix about two and a half inches out from the vagina, and demonstrated marked cystocele together with rectocele, and associated diastasis of the levatores ani. The uterus was curetted, and large wedges excised from the cervix. A fortnight later—November 25, 1913—the abdomen was opened, and the cardinal and round ligaments looped. On immediate examination in the lithotomy position, the uterus was found to be beautifully fixed in its normal position in the pelvis, the firm fixation being demonstrated by pulling on the sutures which had been used in excision of the cervical wedges. It was also noted that the cystocele and rectocele were much less pronounced. No further operation was done at this sitting because of the presence of a small abscess about the vulva, and unfortunately the patient declined a suggested perineorrhaphy. When she left hospital the uterus was in perfect position.

As to the above operation of intra-abdominal looping of the cardinal ligaments, I trust other surgeons may be encouraged to give it a trial. Certainly it is not an operation to be lightly undertaken, but once the anatomy of the uterine vessels and of the ureter is clearly grasped the danger is greatly minimized. If the operation, with a gradually perfected technic, turns out to be all that I anticipate, it should greatly advance the treatment of uterine prolapse. Its more striking advantages are: (1) The practical absence of hemorrhage; (2) the excellent immediate anatomical result, and almost certain good permanent effect; (3) the comparative absence of post-operative shock, and (4) the absence of raw surfaces.

SIMPLE AND COMPLETE FORMS OF APPARATUS FOR INTRATRACHEAL ANÆSTHESIA.*

BY HENRY H. JANEWAY, M.D.,

OF NEW YORK.

(Published from the Department of Experimental Surgery of N. Y. University and Bellevue Hospital Medical College.)

In the August number of the ANNALS OF SURGERY for 1912, an apparatus for the administration of intratracheal anæsthesia was described for which the advantages of compactness in size and ease of transportation were claimed.

Since that time the apparatus has been improved; both its weight and size have been materially diminished. Because of the useful field which intratracheal anæsthesia is destined to fill, improvements of these characters justify a brief description.

Fig. 1 represents an apparatus which is fitted with only those parts which are considered necessary for intratracheal anæsthesia. It weighs eighteen pounds and measures 15 x 4½ x 5. It may be taken apart into three pieces, by removing the pins in the base plate, and can be carried in a small handbag. It is provided with a safety valve and air filter.

Fig. 2 illustrates a machine designed for hospital work but easily portable. All the parts are attached to one base plate. In addition to safety valve, air filter, and ether jar, it contains provisions for warming and moistening the current of air and for automatically interrupting the same at desired intervals. It runs noiselessly and measures 14 x 10 x 8 inches and weighs 28 pounds.

Fig. 3 illustrates an apparatus containing all the parts mentioned in the description of the machine represented in Fig. 2, but in addition, provision for measuring accurately the current of air and percentage of ether vapor. All these parts are fixed upon one base plate. It weighs 35 pounds and measures 19 x 10 x 8 inches. Dr. Karl Connell has demonstrated the constancy with which definite ether percentages may be adhered to during anæsthesia. This work has been confirmed by Boothby, of Boston, and the author is convinced of the truth of these claims. Ether may, therefore, be administered with greater scientific accuracy and safety to patients when it is possible to accurately control the percentage given.

In this machine the varying quantities of ether are delivered to the vaporizing jar by a piston which can be set to deliver any desired quantity per minute. The quantity of air is measured by the height to

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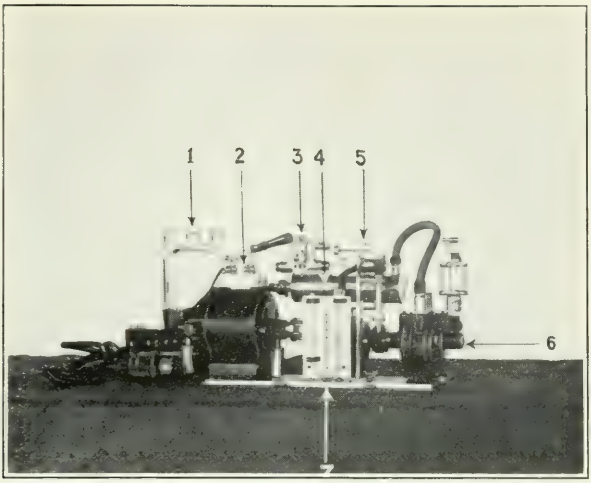
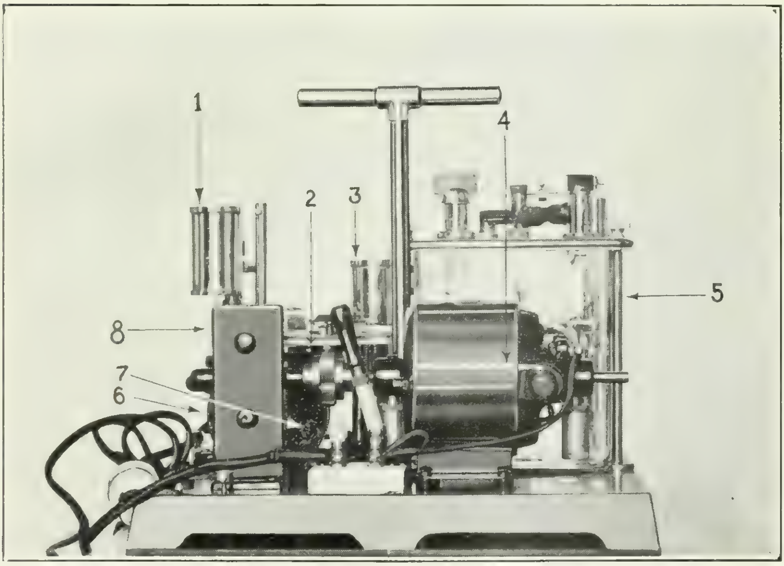
* Read before the American Association of Anæsthetists, June 18, 1913.

FIG. 1.



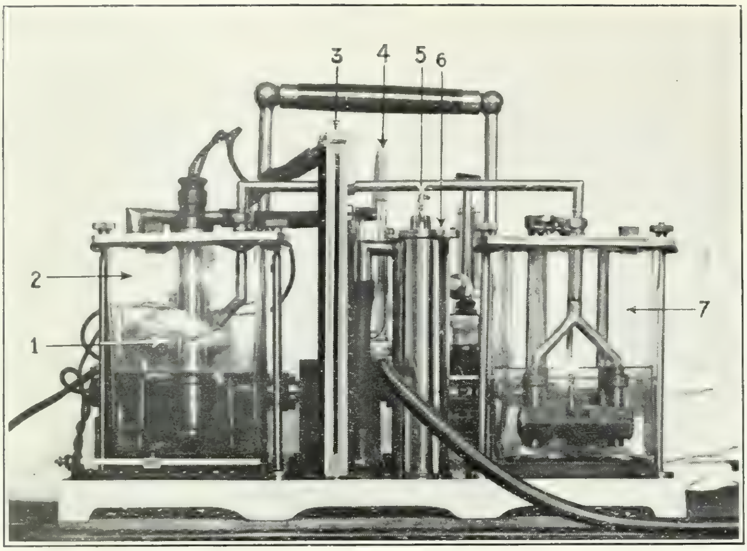
Smallest apparatus for intratracheal anæsthesia, measuring 4½ x 5 x 15 inches and weighing 18 pounds. 1, ether flask; 2, motor; 3, slide valve controlling the percentage of ether administered; 4, air filter; 5, safety valve; 6, blower; 7, manometer.

FIG. 2.



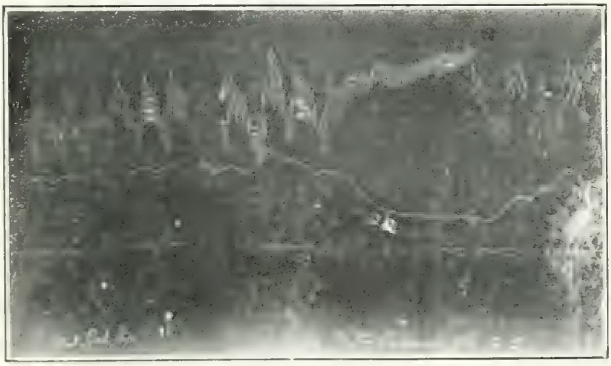
Complete apparatus for intratracheal anæsthesia except for means for measuring ether percentages. Weighs 28 pounds and measures 10 x 14 inches. 1, muffler and air filter to intake of blower; 2, worm wheel which operates the interrupter to the current of air; 3, second air filter between the blower and ether flask; 4, motor; 5, ether flask; 6 and 7, blower; 8, gear box.

FIG. 3.



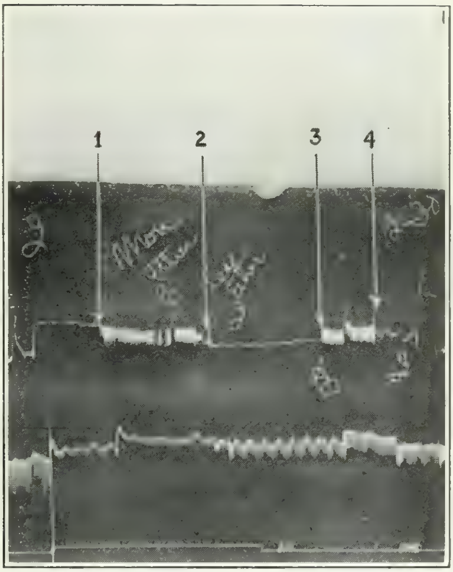
Apparatus for intratracheal anæsthesia with provisions for measuring ether percentages. Weighs 35 pounds and measures 19 x 10 x 8 inches. 1, motor seen through the volatilizing flask; 2, volatilizing and warming flask; 3, air meter; 4, manometer; 5, safety valve; 6, air filter; 7, ether flask

FIG. 4.



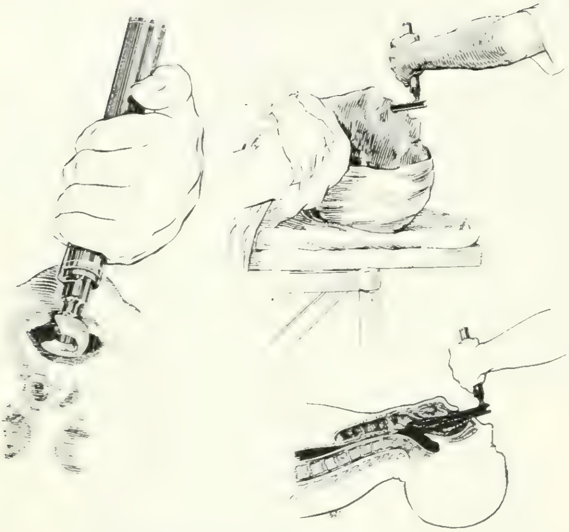
Showing diminution of blood-pressure and output per heartbeat when intrabronchial pressure was raised from 10 to 22 mm. Upper tracing measures the output per beat of the heart. Lower tracing measures the blood-pressure.

Fig. 5.



Illustrates effect upon respiration when the current of air is interrupted with the thoracic cavity open. Upper tracing, the respiration curve; lower tracing, the blood-pressure curve between 1 and 2, and between 3 and 4 the current of air was not interrupted.

Fig. 6.



Illustrating the position of the head of the author's self-lighting speculum for catheterizing the trachea. The speculum is roofed to the distal end, which is curved in a manner to direct the distal end of the catheter forward from the œsophagus and into the larynx and yet it permits of a direct view of the larynx. The battery is enclosed in the handle.

which a float rises within a perpendicular tube, the lumen of which is shaped like a truncated cone. The higher, therefore, that the float rises the larger is the circular space around it and between it and the walls of the tube. This form of meter works accurately and may be tested at any time in the offices of any gas company.

We have tested it by a wet meter purchased for the purpose and have found no variations during a period of several months.

All these machines work on both the alternating and direct current.

When the author first used this machine he was not entirely assured that the administration of ether in known percentages offered a material advantage, especially if the services of an expert anæsthetist should be at hand. In whatever manner ether is administered, the physiological effect upon the patient is the only safe guide to the amount of ether which should be given. While it always is a satisfaction to know the amount of air and the percentage of ether which the air contains, this knowledge can only be obtained at the expense of adding to the apparatus extra parts for this purpose.

Continued use of the machine has convinced the author that a knowledge of both the amount of air and the quantity of ether administered per minute is more than a satisfaction. It prevents, on the one hand, inconveniences amounting sometimes to actual dangers from the use of improper quantities of air and renders possible the administration of ether with far greater accuracy.

The device for mechanically interrupting the current of air is to be viewed in the same light. Regularly interrupting the current of air makes no difference in the blood-pressure, when the current of air is supplied within the pressure limits which are indicated during intratracheal anæsthesia.

It is well to remember that at a high pressure, which sometimes may occur accidentally, the pulmonary circulation can be sufficiently compressed to reduce seriously the output of the heart and the general blood-pressure. This change is illustrated in Fig. 4.

The great benefit from regularly interrupting the current of air is noticed during intrathoracic operation when the thorax has been opened. Fig. 5 illustrates the contrast during the same stage of anæsthesia between the excessive respiration occurring when a constant current of air was supplied and the almost entire cessation of efforts at respiration during the periods in which the current of air was regularly interrupted.

The arrangement for automatically interrupting the current of air on these machines, in no way complicates them and is preferable to relying upon the anæsthetist for their production.

It will be noticed that all these machines are open and simple in construction. All parts are easily reached.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, held at the New York Academy of Medicine, December 10, 1913.

The President, Dr. Frederic Kammerer, in the Chair.

FRACTURE OF THE HEAD OF THE RADIUS.

Dr. William Darrach showed two cases, with stereopticon illustrations of the X-ray findings. The first patient was a woman, twenty years old, who, on January 10, 1912, fell, striking on her right elbow. There was sharp pain over the radial head, with greatly impaired function. On the day following the injury, after an attempt at reduction under chloroform, the X-ray showed two loose fragments and an operation was advised. At this time there was great tenderness over the radial head, which was increased by pronation and supination. The head of the bone moved with the shaft. Flexion was limited to 45 degrees; extension to 150, while pronation and supination were slightly limited.

Operation, January 18, 1912: With the elbow flexed to 90 degrees, a curved incision was made over the dorsal aspect of the radiohumeral joint; this was deepened through the external lateral and orbicular ligaments, and the joint was opened. One fragment, which was loose and quite separate from the rest of the bone, was easily removed, but a second piece was dislodged with some difficulty, as it lay deep in the wound. Its removal was accomplished, however, and the wound was then closed with catgut and silk. The first dressing was made on the fifth day, when the stitches were removed. The wound healed primarily, and motion was begun on the tenth day. An X-ray, taken about a fortnight later, showed that a third fragment had been overlooked, but as flexion was then possible to 50 degrees, no attempt was made to remove it.

At the present time, 23 months after operation, there was flexion to 35 degrees, but extension was limited to 160 degrees, apparently by bony contact. Pronation and supination were complete. There was no pain nor decrease in power. The indications for operation in this case, the speaker said, were the faulty position and complete separation of the fragments.

Dr. Darrach's second case of fracture of the head of the radius was that of a man of thirty-two, who, on February 18, 1913, fell off the lowest step of a ladder, striking on the outer aspect of his left elbow against a concrete floor, the elbow resting against his side. Following the injury there was a moderately sharp pain over this region, and the forearm hung limp. It was bandaged and put in a sling and then put up in plaster for two weeks. After an X-ray was taken, an operation was advised, and the patient was brought to Roosevelt Hospital.

On the seventeenth day after the injury an incision was made over the dorsal aspect of the radiohumeral joint, and an attempt made to replace the loose fragment, which consisted of the outer half of the head, and a small portion of the neck. This was unsuccessful, and it was removed. The wound was then closed, and the arm put up at right angles in a starch bandage. When the bandage was removed and the stitches taken out twelve days later, the wound was firmly united. At this time there was flexion to 85 degrees; extension to 130 degrees; pronation 20 degrees, and supination 60 degrees. A week later there was flexion to 70 degrees, extension to 145 degrees, 60 degrees of pronation and 75 degrees of supination. Eight months after the operation there was flexion to 45 degrees, extension to 165 degrees, with 90 degrees of pronation and supination.

Dr. Darrach said it should be possible to replace a single fragment, providing it did not involve too much of the head of the radius and the attempt was made sufficiently early. In this case, which was done on the seventeenth day, there was too much new tissue deposited to allow of accurate apposition.

Dr. John A. Hartwell reported the case of a young woman who fell through a plate glass door, striking on her arm and receiving a fracture of the head of the radius, of which the speaker showed an X-ray picture. The injury was first treated by flexing the arm at a right angle and later by partial flexion. At the present time, the patient had good function, with practically complete flexion, but some limitation of extension.

Dr. Ellsworth Eliot, speaking of the presence of loose fragments in fractures of this nature, said he did not think they were of any special harm, irrespective of their position, but by becoming attached to some part of the articular surface, they might readily interfere with motion, particularly with extension and possibly with rotation. Two or three years ago he had a case where the X-ray showed multiple small fragments. After opening the joint, he introduced a small Nelaton catheter and washed out the joint with sterile saline solution, and during this process the small particles of bone came away. Some of these were as large as a pea, while others were very small fragments, and could not readily have been removed in any other way. An irrigation of the kind is almost certain to remove them and that too, with the least degree of trauma to the joint structures.

Dr. James M. Hitzrot reported the case of a girl, twenty-six years old, who fell forward, striking on her extended hand. An X-ray was taken, which showed an injury similar to that portrayed in Dr. Darrach's first case. Upon opening the joint, he found a fracture through the head of the radius, and of the capitellum, with a fragment of the capitellum engaged in the fracture line. In this case, Dr. Hitzrot said, he removed the head of the bone, because he had seen several cases where supination was more or less interfered with when the fragment was left behind. In his own case, of which he showed the specimen, the woman obtained excellent function in spite of the fact that the head and part of the neck of the bone were missing.

Dr. Darrach said they had had in the Out-Patient Department 20 cases of fracture of the head of the radius, during the last three years, which had been treated without operation. Of ten of these, whose X-ray plates had been gone over, five showed a fissured fracture of the head, with slight or no displacement, and the other five showed a fracture of the neck with more or less impaction. The results in these, as far as they had been traced, were satisfactory. Some showed a little limitation of pronation and supination, and many of them showed slight limitation of extension. In cases where there was little or no displacement of the fragments, it was wise, the speaker thought, to try conservative methods.

In addition to the cases shown, Dr. Darrach said he had operated on five other injuries to the radial head. One comminuted fracture of the head, where the whole head and neck was removed, showed perfect supination and pronation, and perfect flexion and extension. In two anterior dislocations of the head, associated with fracture of the ulnar shaft, the head and neck were resected in one case, with complete restoration of motion, while in the other case the dislocation was reduced, after re-fracture of the ulna, by cutting through the orbicular ligament. The remaining two cases were fractures of the radial head associated with posterior dislocation of the ulna at the elbow. The head and neck were removed in both. Pronation and supination were restored, but there was limitation of flexion and extension due to other causes.

When the loose fragment involves a considerable portion of the internal aspect of the radial head, it is wiser, Dr. Darrach thought, to remove the whole head and neck. Otherwise, the changes at the superior radio-ulnar joint would materially interfere with pronation and supination.

PYLOROPLASTY FOR GASTRIC ULCER.

Dr. James M. Hitzrot presented a laborer, twenty-nine years old, who was admitted to the New York Hospital on January 27, 1913, complaining chiefly of a pain in the right upper quadrant of the abdomen. He stated that he had suffered more or less from abdominal pain for the past fourteen years. In October, 1911, he had been operated on for cholelithiasis, and in the following February the abdomen was again opened, when a " wound in the gut " was repaired. Following this second operation he had an attack of vomiting about every three weeks, associated with severe epigastric pain. On July 1, 1912, a gastro-enterostomy and appendectomy was done at the Mayo Clinic, and following this operation the patient had remained perfectly well for three months.

Present History: For ten weeks prior to his admission to the New York Hospital the patient had suffered from pain in the right upper quadrant, just below the costal margin. This pain was intermittent in character, and at times was so severe that he had fainted. It radiated through to the back, but never upward to the shoulder blades, and usually came on from half an hour to one hour after taking food.

Examination showed an indefinite mass on deep respiration in the right kidney region. There was a small hernial protrusion through a scar of the right rectus, with considerable tenderness over the upper part of the scar. Several blood counts were taken, which showed 100 per cent. of hæmoglobin, with 6,000,000 red cells, 15,000 leucocytes, and 64 per cent. of polynuclears. The von Pirquet test was strongly positive within twenty-four hours.

Operation by Dr. Hitzrot, February 4, 1913: A right rectus incision was made above the umbilicus through the old scar, and upon entering the peritoneal cavity, a mass of adhesions was found, especially about the gall-bladder. The pyloric region was freed from adhesions, and upon examining the stomach, the old gastro-enterostomy opening was found to be closed. The pyloric ring was narrowed and indurated, especially anteriorly and on the duodenal side of the pylorus. A typical Finney pyloroplasty was done, and on completing the anastomosis between the stomach and the duodenum, the opening was large enough to easily admit the tips of three fingers. The wound was then closed, a small cigarette drain and two pieces of gauze packing being left in the abdomen for drainage.

The wound healed primarily, and the patient was allowed up on the tenth day. He was discharged on February 15, 1913, and since then had been entirely relieved from pain and other symptoms of gastric disturbance. The diagnosis in this case was chronic ulcer of the stomach.

Dr. Eliot said that recently he had been interested in the radiographic findings of the passage of bismuth through a gastro-enterostomy orifice. From a number of cases which he had studied, including not only those within a month after operation, but also those in which an interval longer than a year had elapsed, the size of the opening seemed to make little difference. In each instance only a very small-sized stream of bismuth found its way through, and he had come to the conclusion that most of the bismuth passed through the pylorus and comparatively little through the gastro-enterostomy orifice.

Dr. Arpad G. Gerster said he recalled a very important and interesting observation regarding the closure of the gastro-enterostomy orifice that occurred about six years ago in the practice of Dr. J. Kaufmann. The patient, Dr. Gerster said, came under his care on account of a gastrocolic fistula, as the result of which he was passing formed fæces through his mouth. Several years prior to that time he had had an ulcer of the pylorus, for which a gastro-enterostomy was done by Dr. F. Lange. Dr. Lange followed the usual method of those days, also doing an entero-enterostomy—the Y-shaped operation first practised by the French surgeon Roux.

Dr. Gerster said that when he came to operate on this patient, he found that the entero-enterostomy, so far as the adhesions between the two segments of the small intestine were concerned, still persisted, but the communication between them had been obliterated. The site of the gastro-enterostomy, however, could not be located. The openings in stomach and jejunum had not only been obliterated, but the adhesion between the stomach and small intestine had been entirely resolved and abolished. The pylorus had resumed the normal shape, so that the finger could be invaginated through the pylorus into the duodenum. This, the speaker said, was the usual course of events, and as soon as it took place, the gastro-enterostomy orifice closed. If the ulcer recurred, as it was very apt to do, because the operation did not obliterate the patient's vice to re-form ulcers, then we had to deal with a renewal of all the symptoms. As long as there was irritation, adhesions would form, and with the cessation of irritation, adhesions would have a tendency to be abolished and the normal conditions to be re-established.

MULTIPLE LIPOMATA.

Dr. Hitzrot presented an Italian, forty-three years old, who was admitted to the New York Hospital on December 1, 1913, with the history that about three years ago he first noticed several small, soft masses on his shoulders and the back of his head. These increased rapidly in size and during the past six months one of the tumors on the back of his neck had become painful. Eight months ago, two similar growths appeared on the anterior abdominal wall.

Examination showed multiple tumors of varying size over the body and extremities. These were lying underneath the skin, soft, globulated and painless. There was a mass, the size of a lemon, on each side of the posterior surface of the arms between the elbow and shoulder. A small tumor could also be felt beneath the right mammary gland, and similar masses were found on the anterior abdominal wall, on both thighs, over the clavicle and the anterior surface of the forearms.

On December 4, 1913, Dr. Hitzrot removed the tumor on the right side of the neck, which was giving rise to pain. Its removal was accomplished with some difficulty, because of the presence of dense, fibrous adhesions.

Dr. Hitzrot said there was no history of alcoholism in this case, and there were no physical signs of any tuberculous process in the lungs.

Dr. Charles A. Elsberg said that four or five years ago Dr. John F. Erdmann showed a case of multiple symmetrical lipomata, and three or four months prior to that time the speaker said he had presented a similar case, shortly after Marie had described the condition of symmetrical adenolipomatosis. Marie contended that these lipomatous growths contained adenoid tissue, that the condition was usually met with in alcoholics and that the patients were apt to succumb to tuberculosis. In his own case, Dr. Elsberg said, the patient died three or four years later of pulmonary tuberculosis.

Dr. Otto G. T. Kiliani said that at one of the meetings of the Society at the German Hospital, he showed a case of symmetrical lipomatosis involving the arms and abdomen, and the case was subsequently published, with a photograph, in his book on Surgical Diagnosis. In that case he removed one of the large tumors, and when he last saw the patient, about six months ago—perhaps eleven years after the operation—he found that a number of the smaller growths that had been left had greatly increased in size. The patient was otherwise in good health and showed no evidence of any pulmonary trouble.

PERFORATING TYPHOID ULCER.

Dr. Otto G. T. Kiliani presented a young man who was admitted to the German Hospital on October 6, 1913, with the history that he had been feeling ill for two weeks. During this period he had suffered from cough and frequent vomiting, followed by abdominal pain, diarrhœa, chills and fever. He had remained at work.

On admission, the patient complained of pain and tenderness under the left costal margin, and of great weakness. The lungs gave evidence of a diffuse bronchitis. The abdomen was soft, and slightly distended, with some tenderness in the appendicular region and numerous "rose spots." The spleen was enlarged.

The temperature, on admission, was 104.5°. Three days later it rose to 106.5° and then suddenly dropped to 97°. Accompanying this the pulse was weak, but low, and the patient complained of a fairly acute pain on the right side of the abdomen, below the navel. There was slight rigidity of the right rectus, together with exquisite tenderness in the right lower quadrant.

The case was recognized as one of perforating typhoid ulcer, and when Dr. Kiliani opened the abdomen through the outer edge of the right rectus, he found four or five intestinal ulcers, one of which had perforated, while the others appeared ready to perforate. He thereupon resected the appendix and used its mesenteriolum to cover the perforation of gut. He then simply washed out the abdomen and closed the wound, without drainage.

Following the operation, the patient's temperature again rose to 105.5°, and the case ran an uneventful typhoid course for four days, when symptoms of retention developed, with a sudden drop in temperature and evidences of a second collapse. Upon investigation it was found that the abdominal wound had broken down and showed evidences of infection. The wound was cleansed and permitted to remain open, and from that time on, with the exception of two relapses, the typhoid fever ran its usual course and the patient's further recovery was uneventful. He now had a large hernia, however, at the site of his abdominal wound.

In connection with these cases, Dr. Kiliani said, the question arose whether to drain or not to drain. The chief objection to drainage was that we left a foreign body in contact with the inflamed gut and were thus apt to produce further perforations.

Dr. William C. Lusk said that he had recently operated upon a case of typhoid perforation, who recovered, at Bellevue Hospital in the service of Dr. T. A. Smith. Through the Kammerer incision he had closed the perforation, which was situated about five inches from the ileocæcal valve, using one continuous stitch of No. O chromic gut to bring together the edges of the perforation, and two outer rows of Pagenstecher linen thread inverting the first stitch line. Seropus which was found on the right side and in the pelvic cavity was removed with the Kenyon and Pool aspirating nozzle (*Surg., Gyn. and Obstets.*, December, 1909). A glass drainage tube was placed in the pelvic cavity through a suprapubic stab wound, and a gauze strip introduced within it. The deep transrectus wound was closed in two tiers with chromic sutures, the deeper row being mattress sutures which included peritoneum and rectus muscle. A rubber tissue drain was inserted down to the rectus muscle in the lower angle of the wound. On the third day smears from the pus in the bottom of the glass drain did not show the presence of any bacteria. After a few days the abdominal incision broke open, a loop of adherent intestine presenting prominently in the interval. This piece of bowel was gradually reduced into the abdominal cavity and the skin edges finally drawn closely together by strapping the wound with adhesive plaster.

Regarding peritoneal drainage Dr. Lusk said that Petroff, of Warschau (*Zentralbl. f. Chir.,* No. 31, 1913, p. 1215), by experiments on 37 rabbits had demonstrated that the removal of fluid from the peritoneal cavity was most effectually accomplished by means of glass drains with wicks, since a drain of this sort stimulated the formation of hardly any adhesions and would continue to abstract fluid out of the general peritoneal cavity for more than 48 hours, while gauze was effectual to drain for only 5 to 6 hours. He also said he regarded that the recovery of this case was due not entirely to an early diagnosis having been made, the patient having been operated upon just 3 hours after the occurrence of the perforation, but in large measure as well to the fact that the patient had been fed with the high caloric diet originated by Dr. Warren Coleman (*Am. J. Med. Soc.,* January, 1912) as a therapeutic measure in the treatment of typhoid fever. Thus, this patient instead of coming to operation for an acute peritonitis, emaciated and delirious as was usual under the former methods of treatment, was very well nourished, in a normal state of mind, and consequently in a favorable condition to resist the ordeal necessitated by his complication. The patient suffered no shock from his operation and except for the suppuration and opening up of the wound, recovery was uneventful.

Dr. Kiliani rejoined that in most of the cases of operation for perforated typhoid ulcer which had come under his observation where the wound had been closed without drainage, the sutures had subsequently given way. He had no explanation to offer why this was so, but he had an impression that if the sutures had not given way in these cases, a fatal issue would have been more apt to occur. He recalled another case reported to the Society, 1906, where there were two perforations of the ileum and one of the gall-bladder. The man was apparently progressing favorably after the operation, but he succumbed on the tenth day from pneumonia.

Dr. Killiani said he had seen the statement that 25 per cent. of these cases were saved by operation. These figures seemed to him rather high, unless we took into consideration the fact that the favorable cases were more likely to be put on record than those that had resulted unfavorably.

Dr. Clarence A. McWilliams said they had had 20 cases of perforated typhoid ulcers at the Presbyterian Hospital up to three years ago, with five recoveries after operation—25 per cent.

HERNIA OF THE LARGE INTESTINE, WITH SPECIAL REFERENCE TO "SLIDING HERNIA."

Dr. A. V. Moschcowitz presented a paper with the above title, for which see page 610.

Dr. Arthur S. Vosburgh said the paper of Dr. Moschcowitz and his diagrams of sliding hernia were a great help to the clear understanding of this subject. When a year or so ago he read Dr. Hotchkiss's paper on the treatment of sliding hernia, he was unable to follow clearly the steps there described in the treatment of the sac. Not until he had a case of sliding hernia of the ascending colon, and had attempted to describe to the house surgeon the method of repair, had he fully appreciated the difficulties of a written description.

In a recent case, that of a very old man, operated under novocaine, he came down upon tissue that did not seem to belong to a hernial sac. Incision of this tissue excited free bleeding, and further attempts to enter the sac at this point were abandoned. The peritoneal cavity was entered in the neighborhood of the internal ring, and then the explanation of the condition was clear. A sliding hernia of the ascending colon, the tissue that bled freely on incision, was the non-peritoneal surface of the ascending colon, being covered by the lymphatics and blood-vessels that supply the ascending colon. On inspecting the neck of the sac, it was found that the ascending colon occupied two-fifths of the ring. If approach to the sac from this side had been persisted in, the lumen of the gut would have been entered, and much damage to the blood supply of the colon would have resulted. Recalling Dr. Hotchkiss's paper, his description of the treatment of the sac was then perfectly clear. Splitting the sac longitudinally he apportioned two leaves, to form a new mesentery for the colon, pushed the colon well into the abdomen, and anchored it there. The mouth of the sac was then closed with purse-string suture, and the inguinal canal repaired in the usual way.

Dr. L. W. Hotchkiss said he had seen a number of these cases of "sliding hernia" at Bellevue Hospital and elsewhere. The patients were usually adults, past middle life, with a moderate-sized hernia which it was very difficult to control with a truss. In the first case he saw, the hernia involved the descending colon and the sigmoid flexure. Operating by the method then devised to meet the emergency, and which he has described, he found that the contents of the sac were easily replaceable: *i.e.,* by splitting the sac well down in front he formed a sort of mesentery which allowed the gut to be replaced without injury and then the rest of the opening was closed by purse-string suture in the usual manner. Subsequent to that he encountered several of these cases in succession, and the operation he had devised gave admirable results in dealing with these cases, the smaller sliding herniæ of the right side as well as the large sliding variety on the left side.

Dr. Burton J. Lee said that about three years ago he saw a case of "sliding hernia" on the right side, and on operation it was found to include the ascending colon. The case resulted fatally from acute intestinal obstruction and peritonitis. In this case, the speaker said, the fatal result had been due to a replacement of the bowel directly inward, rather than upward and outward behind the peritoneum.

Dr. William B. Coley said he had been much interested in the subject of "sliding hernia" for many years, and a large number of these cases had come under his observation at the Hospital for the Ruptured and Crippled and at the General Memorial Hospital. He did not quite understand why Dr. Moschcowitz advanced such an arbitrary rule in regard to the pathogenesis of the condition, as it was at variance from that long held by other men and with his own experience.

Dr. Coley said that in spite of theoretical objections regarding its etiology, we must recognize that this form of hernia, sliding hernia of the cæcum, does occur. Personally, he was inclined to believe that it was the result of a congenital malformation, and that, while the cæcum may be covered by mesentery, in certain cases it was not.

Finsterer (*Beitr. z. klin. Chir.*, November, 1912, Bd. 81, p. 198) recently reported three cases of sliding hernia, two of which were of the cæcum. Hilgenreiner in his statistics, comprising 2238 cases, reported 8 cases in which the cæcum formed part of the sac.

At the Hospital for Ruptured and Crippled, up to December, 1912, the sigmoid was found in the sac 5 times; the cæcum alone in 7 (these cases were of the sliding variety), the appendix alone was found in 15 cases.

As to the operative treatment of sliding herniæ, the speaker thought the method advocated by Dr. Moschcowitz was a very excellent one and was similar to that described by Dr. Hotchkiss. Dr. Coley stated that in certain difficult cases, he believed that the procedure described some years ago by Fiaschi, of Sydney, Australia, in which the cæcum or sigmoid, after reduction, is fastened by suture to the anterior abdominal wall, was a good one; in ordinary cases, he had not found it necessary.

Dr. Moschcowitz, in closing, said that while with the ordinary variety of "sliding hernia" the descending and ascending colon only were involved, even the small intestine might be involved, and he recalled one case of Dr. Gerster's where there was a "sliding hernia" of small intestine. We could imagine a very large hernia on the left side with the entire mesosigmoid unfolded, then we would have a "sliding hernia" of the sigmoid flexure, but not until then. A "sliding hernia" of the bladder was very common, and the speaker said he had seen a "sliding hernia" of the uterus, but the common variety was that of the ascending or descending colon and not of the sigmoid flexure.

BOOK REVIEW

SURGERY OF THE EYE. By EDWIN TOROK, M. D., and GERALD H. GROUT, M.D., p. 485. Lea & Febiger, Philadelphia.

The plan of this book as outlined in preface, namely, the disease, the selection of operation, detailed steps of operation, list of instruments required, complications and first operative care, is followed closely and admirably carried through the book.

The first part, covering 120 pages, deals with general surgical methods. In twelve pages the post-operative complications are ably and concisely discussed.

Pages 65 to 121 are devoted to a systematic description of instruments and their uses and contain valuable hints to beginners.

Part II is prefaced by eight pages on the surgical anatomy of the eyeball and in the remaining 337 pages the operations on the eyeball and appendage are taken up in logical sequence.

The book finishes with a chapter of sixteen pages on removal of foreign bodies.

Among the more recent operations and those not described in detail in the current surgical text-books are Legrange's sclerectomy and sclerecto-iridectomy, Heine's cyclodialysis, Elliot's trephining of sclera, Toti's operation on nasal duct. The technic in use of Schiotz tonometer, and the technic of keratoplasty.

This book is well written, compact and yet as comprehensive as was possible in 400 pages. It may not give quite the personal touch or impart the individual experience noticeable in some edited in recent years but the selection of operation and methods are well chosen and painstakingly described. The description of the more modern operations will be appreciated.

One excellent feature of the book is its wealth of original illustrations which, together with the concise and lucid text, can hardly fail to impart to the beginner a good understanding of the operation in question. Altogether this volume is a distinct contribution to the existing books on ophthalmic surgery.

P. CHALMERS JAMESON.

INTERNATIONAL SURGICAL ASSOCIATION.

THE Fourth Congress of this Association will be held at the Hotel Astor in New York City lasting four days, beginning Monday April 13, 1914. This is the first time that the Congress has ever had a meeting outside of the City of Brussels, where the first one was held in 1905 and repeated every three years. The membership of the Association is limited to a certain number from each country. The membership in the United States is about one hundred. The President of the Fourth Congress is Professor Depage of Brussels, Professor Willems of Ghent is President of the International Committee, and Dr. L. Mayer of Brussels is the General Secretary.

The programme is limited to consideration of three main topics:

First, Gastric and Duodenal Ulcers. Introduced by papers by De Quervain of Basel, Hartmann of Paris, Lecene of Paris, Mayo of Rochester, Minn., Moynihan of Leeds, Payr of Konigsberg.

Second, Grafts and Transplantations. Introduced by papers by Morestin of Paris, Villard of Lyons, Ulmann of Vienna, Lexer of Jena, and Carrel of New York.

Third, Amputations. Introduced by papers by Witzel of Dusseldorf, Ceci of Pisa, Kuzmik of Budapest, Binnie of Kansas City, Durand of Lyons, and Ranzi of Vienna.

After the close of the Congress, Thursday, April 16, most of the foreign members will make a tour of other cities, the itinerary including Philadelphia, Baltimore, Washington, Chicago, Rochester, Minn., Montreal, and Boston.

ANNALS OF SURGERY

VOL. LIX MAY, 1914 No. 5

ORIGINAL MEMOIRS.

THE TECHNIC OF COMPARATIVE HYPERÆMIA.

(MOSZKOWICZ'S SIGN.)

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IT IS certain that as yet a definitive diagnostic value cannot be put upon comparative hyperæmia (Moszkowicz's sign), but it is still another means, and undoubtedly a most important one, placed at the disposal of the surgeon in estimating the proper point of amputation in cases of gangrene of the limbs. Nevertheless, the arterial pulsations should be sought for, the local temperature and cutaneous sensibility noted. When the hyperæmia is *perfectly distinct in its limits* it may be said that then the proper site of the amputation is absolutely indicated.

The object of the present paper is to indicate as clearly as possible the proper technic to be employed in the search for Moszkowicz's sign in order to avoid certain errors which might otherwise occur, and at the start it will be taken for granted that the reader is familiar with the principles upon which this diagnostic sign is based. The experiment consists in applying a rubber band at the root of the limb presenting gangrene, likewise one on the healthy mate, and then comparing on both limbs the rapidity and degree of color of the cutaneous hyperæmia following the removal of the constricting bands.

In principle, one proceeds as follows. The venous blood is emptied as best possible out of the two limbs, in order to avoid any error in interpretation later on. A hæmostatic band is then applied at the roots of both limbs, which should be allowed to remain sufficiently long to produce anæmia of the tissues. The elastic bands are then simultaneously removed on both sides, and the observer follows the redness which extends from above downward on each extremity, at the same time noting the rapidity, the degree of color, and the point at which it stops.

These various stages of Moszkowicz's sign can be interpreted in several ways, and for this very reason it is essential to consider their execution in detail. The patient is placed in the dorsal decubitus and the venous blood is then expelled in various ways from the members to be examined. The simplest way is vertical elevation of the limb, as by gravity the column of venous blood makes its exit, but in order that the emptying shall be thorough this position must be maintained sufficiently long in order to avoid the return of the venous blood after arterial hæmostasis. In point of fact, in these cases the limb, instead of taking on the livid hue of nonvascularized tissues, assumes a violet tint which becomes confounded with the redness following the removal of the hæmostatic band. Here is a cause of mistake that must be eliminated at any cost, above all in the first trials made. Afterwards, from habit, it will be an easier matter to interpret the experiment, in spite of the cyanosis due to venous stasis.

In normal limbs, when the hæmostatic band is removed, there is a rapid regression of the violet hue which leaves the tissues decolorized after it. This paleness, succeeding the cyanosis and preceding the cutaneous hyperæmia, is to be interpreted in part like the latter; its rapidity and stopping point are the same as for the redness. Alone the tint does not vary. However this may be, the interpretation of these facts can only be arrived at when *both* limbs are cyanotic, a condition which is not usually met with. Consequently, it is better to avoid venous stasis with all the means at our disposal.

Many patients suffer intolerable pain when the diseased lower limb is maintained in a vertical elevation, and therefore it is important to prolong this position as little as possible. Instead of allowing the venous blood to flow out by gravity, this may be hastened by massage directed toward the root of the member. An excellent means is to apply an elastic bandage, starting from the distal end and bringing it up to the upper part of the thigh, thus following the direction of the venous flow. This procedure, currently employed in operations for avoiding venous stasis, has the advantage of emptying with the greatest force the limb to be operated on. But a shadow dims this procedure, for it is to be feared that in cases of embolus a clot which has not become organized may become detached. However, it can be said that in the cases here considered, I am unaware that this accident has ever been recorded, and personally I have never had any disturbance of this kind in the few cases where I have employed it.

Arterial hæmostasis should be made as high up as possible at the root of the limb—at the axilla in the case of the arm, at the groin for the lower extremity. It is preferable to employ a rubber band or tube. Esmarch's tube is the one that produces the greatest degree of anæmia on account of its great compressive power, but in one case recorded by Mendelsohn it was powerless to compress the femoral artery on account of the rigidity of the walls of the vessel due to sclerosis. Some operators refuse to use it in cases of atheromatous gangrene, fearing that it might break the brittle vascular walls, but in cases in which it has been employed for Moszkowicz's sign it has given rise to no trouble. Personally I have never used it, simply because I preferred the flat band, which does not cut into the flesh so much and still produces quite sufficient anæmia for the production of the phenomena searched for. *Always bear in mind that a cyanosis subsisting in a limb after hæmostasis is applied may be due to an insufficient compression.*

The question of the duration of the hæmostasis is also important. The band should be left on long enough for the hyperæmia, following its removal, to be very marked, so as to give a distinct redness. However, the constriction becomes very painful, even in normal limbs, when too long continued, and in a subject with gangrene it often sets up, from the commencement, severe pain in the diseased member. The pain is localized only in the portion involved by the pathologic process, commencing soon after the application of the band and ceasing only after the latter has been removed. The character of the pain varies, but generally it is of the intolerable shooting type; occasionally the patient will only be aware of a dead sensation or tingling localized in the gangrenous parts. When the band is removed the pain disappears and the patient experiences an agreeable sensation of warmth in the entire limb, and particularly in the part where the pain was severest. When the pain has been unbearable, I have resorted to somnoform, which has given the necessary relief without a profound narcosis.

The hæmostasis should be maintained for at least five or six minutes, when the anæmia will be sufficiently marked to contrast well with the hyperæmic redness. When the hæmostatic bands are removed great care must be taken that this be done simultaneously on both the diseased and healthy side. This is absolutely essential in order to estimate the rapidity of the hyperæmic wave and to compare it with the healthy side. As soon as the bands are removed both limbs are placed on the bed in the horizontal position. If the condition of the patient is such as to permit of being raised up, the reading of the sign may be done in the vertical position and this is advantageous, inasmuch as the progress of the flush can be observed on all aspects of the limb. But if the vertical position cannot be assumed without delay it must not be resorted to, as otherwise the wave of blood would be lost to the observer. In the upper extremities the horizontal position is also advantageous, because, if the arms are allowed to hang down the redness descends too quickly and the requisite details of the test are lost.

The best possible light is also very essential. This detail is far from useless, particularly in doubtful cases in which the hyperæmia is pale, or when there is partial arterial occlusion or an imperfect arterial hæmostasis. Too much light, on the other hand, is not to be desired as it might blind the eye of the observer. It is better to turn the back to the light, for then there is no reflection and one can distinctly estimate the degree of redness following the removal of the bands. This stage of the examination, which is the *reading* of Moszkowicz's sign, is the most important.

As has been said, the integuments must have been prepared so as to offer a livid paleness. When the expression of the venous blood has been improperly done, when the arterial compression has been insufficient, a violet line results which greatly hinders the experiment.

As soon as the bands are removed a uniform, dark red blush normally invades both limbs from the point of compression to the tips. This blush progresses with the same rapidity on both sides, upon the express condition that the constriction is removed simultaneously. When there is arterial occlusion on one side the characters of the hyperæmic wave are changed, and it is upon this difference in the character of the diseased limb, compared with that of the healthy one, that the interpretation of the experiment is based.

There are three phenomena which vary in the hyperæmic wave in a limb the seat of arterial occlusion, namely, the rapidity of the wave, the intensity of its color, and its stopping point. In some instances both red bands progress with equal rapidity in the direction of the arterial flow, the only difference being that in the diseased limb there is a sudden cessation of the hyperæmic wave at the level of the vascular obliteration. In other cases the hyperæmia is very much paler on the diseased side and progressively fades from above downward, becoming blended at a point, difficult to distinctly recognize, with the paleness of the non-vascularized integuments. Between these two extremes there is a mean term, in the distribution of the hyperæmia.

When the constriction is removed the hyperæmia covers both limbs with the same intensity up to a certain point, and on the diseased side it suddenly changes in aspect; from a dark red it changes to a pale pink hue which gradually blends with the colorless anæmic integuments of the diseased portion.

It has been said that in some cases both blood waves descend with the same intensity and rapidity up to the point of disease where the wave suddenly stops. But in practice it is not always so, for there may be a certain delay on the diseased side in the appearance of the cutaneous hyperæmia, the healthy side being already almost entirely covered when the phenomenon takes place in the mate. In this case it slowly descends to a certain point on the diseased limb, where it stops more or less suddenly. This slow progress of the hyperæmic wave generally is met with in the pale type.

To the third type, mentioned above in reference to the color, may be added a change in the quickness of the progress of the wave. At first there is a simultaneous departure and equal rapidity of the wave; then the rapidity decreases (in the diseased limb) at a distinct point where the dark red color suddenly stops. Here the pale area, of which we have spoken, progresses slowly.

An important point, often difficult to appreciate, is the estimation of the point where the hyperæmia stops or also the point where the color and rapidity of the waves change in character. In principle, this point varies according to the site of the arterial obliteration, but Moszkowicz considers that it corresponds exactly with the level of the occlusion.

According to the case, the cessation of the hyperæmic wave takes place suddenly on the diseased side in a transversal line. In other instances the level will be different on the external and internal aspects of the limb. Then, again, an area on the member may remain completely pale while the rest is more or less colored by the flush. This occurs more especially in the lower extremities. For example, the external aspect of the leg may remain perfectly pale, while there is hyperæmia of the posterior cutaneous surface.

Such are the conditions met with in practice. At present it seems to me that the diagnostic value of comparative hyperæmia should be limited to cases of gangrene due to vascular occlusion, and in these cases the lower limit of the hyperæmic wave represents the point below which the tissues are no longer nourished. Although the sign of comparative hyperæmia quite nearly coincides with the level of the arterial occlusion in the leg, the same cannot be said when dealing with the thigh, because here it indicates the degree of the collateral circulation. It is, however, of all the clinical signs, the surest guide to the diagnosis of the point of amputation in cases of gangrene. This should be done quite a little above the lower limit of the hyperæmic area, even if one is obliged to sacrifice a certain amount of vascularized tissue.

VACCINE AND SERUM THERAPY IN SEPTICÆMIA.

A CLINICAL STUDY OF THE COURSE AND TREATMENT OF III CASES.

BY A. CAMPBELL BURNHAM, M.D.,
OF NEW YORK CITY.

THE advances in bacteriology and biologic therapy have been so great during recent years that an inquiry into the results of the modern treatment of severe general infections, in which a condition of bacteriæmia is presumably present, needs no further justification.

One hundred and eleven consecutive cases of severe infection have been collected from the records of the Presbyterian Hospital, New York City, in which either the course and symptoms were those of septicæmia, or cultures showed the presence of bacteria in the circulating blood. These cases occurred between 1905 and 1913 and represent, not the therapy of one physician, but rather, the treatment of a group of physicians and surgeons on the various services of a general hospital. Moreover, during this period the recognized methods of treatment have, in themselves, undergone considerable change. During the earlier part of this period vaccines were never used, and serum only rarely, in the treatment of these general infections; and it was not until 1907 that the facilities of the hospital permitted systematic open-air treatment of ward cases.

The diagnosis of septicæmia is a loose one; many cases are often so diagnosed because of a continued fever of several days, or because of a high temperature associated with a localized infection. A few cases during this period have been excluded because of insufficient data on which to make the diagnosis, and throughout the paper the importance of a positive blood culture is emphasized. Cases in which the blood culture was not made, or showed no growth, have been included because, from a clinical stand-point, they resembled the cases of proved bacteriæmia.

The cases are divided for purposes of study into five groups. Such a division is an arbitrary one; many cases might have been included equally well in either of two groups; but, in general, the cases fell naturally into a classification based upon the apparent cause or associated lesion which gave a particular characteristic to the picture of a generalized blood infection. The five classes are as follows:

1. Cases following abortion and labor.
2. Cases following infected wounds and abscesses.
3. Cases associated with osteomyelitis and arthritis.
4. Cases associated with malignant endocarditis.
5. Miscellaneous cases.

The mortality of the entire series (111 cases) was 74, or 66.6 per cent. This high mortality should be taken as an index of the class of cases treated rather than a criterion of the methods of treatment. Cases admitted to the hospital wards are often those in which treatment outside the hospital has failed. They are brought to the hospital after treatment at home has failed to alleviate the symptoms, and because the patients are rapidly growing more feeble. In some hospitals the mortality from septicæmia is given as low as 20 per cent. Such a low percentage must refer to a series of cases, in general, much milder than those included in this paper.

In order to facilitate comparison, the different classes of cases will be discussed separately.

1. *Cases Following Abortion and Labor.*—Under this heading there were 50 cases with a mortality of 54 per cent., the termination of 2 cases being unknown. Thirty cases followed labor and twenty cases followed abortion. In one case abortion was complicated by tonsillitis; and one case started as a pyelitis with septicæmia for which the treatment was an induced abortion.

The result of the blood culture was in accord with the experience of Western, who, in a careful analysis of 96 cases, found positive cultures in 40 per cent. In 22 cases of the present series the blood cultures were positive (44 per cent.), the majority of the positive cases showing streptococci in pure culture. Two cases were due to the bacillus aërogenes capsulatus, two were due to staphylococci and the remainder were streptococcic bacteriæmia.

In Western's[1] 39 cases, 36 showed streptococci, 2 staphylococci and 1 an unidentified coccus. The comparison between cases with positive blood cultures in this series and Western's, a total of 146 cases, is shown below.

	Blood culture positive.	Recovered.	Died.	Result unknown.
Western (96 cases):				
Streptococci	36	10	26	0
Staphylococci	2	1	1	0
Present series (50 cases):				
Streptococci	18	7	10	1
Staphylococci	2	2	0	0
B. aërog. caps.	2	0	2	0
	—	—	—	—
Totals (146 cases)	60	20	39	1

Positive blood cultures then, in puerperal septicæmia, mean a mortality of about 66 per cent., and I have found no records of an extended series of cases in which the mortality of this type of cases was much less than this. These figures will be referred to later in reference to treatment.

The leucocyte count was made in nearly every case, often daily during the febrile stage of the disease. It was generally between 10,000 and 20,000. The count on admission has been studied as to its possible diagnostic or prognostic indications. The average admission count of 18 fatal cases was 19,000; and, of 18 cured cases, it was 14,900. This would apparently indicate that a high blood count is of bad prognostic significance. However, further study shows that the matter is not quite so simple. There were 9 counts of 10,000, or below, and of these 4 died and 5 recovered; there were nine admission counts of 25,000, or above, and of these 5 died and 4 recovered. However, it may be definitely stated that a high leucocyte count generally indicates a complication. Of the nine cases in which the leucocytes were 25,000 or over, this high count indicated a complication in eight cases, and in the ninth case an especially virulent infection by the bacillus aërogenes capsulatus. In each of these eight cases the local condition causing the high leucocyte count finally required operation. The nature of the complication and the final results in cases showing high leucocyte counts are shown as follows:

Complication.	No. of cases.	Operated on.	Died.	Recovered.
Pelvic abscess	4	4	2	2
Pneumonia, empyema	1	1	0	1
General peritonitis	1	1	1	0
Abscess (not abdominal)	2	2	1	1

In order to determine the significance of the leucocyte count in the different types of infection, the fatal and cured cases of positive (blood culture) streptococcic cases were compared. The average admission count of 9 fatal cases was 11,100, of 7 cured cases 12,300. Two cured staphylococcic cases showed counts of 12,500 and 10,300 on admission. Consequently the type of infection had little or no influence on the leucocyte count. Cases doing well under treatment usually showed a diminishing leucocyte count with a diminishing percentage of polynuclear cells, and fatal cases frequently showed a decreasing number of leucocytes with an increase of the polynuclears. This rule, however, was not invariable and in some cases it was found exactly reversed.

Of the complications occurring in puerperal septicæmia, peritonitis was the most common, occurring in thirteen cases; femoral phlebitis occurred in seven cases; bronchopneumonia and localized abscess, each in 3 cases; lobar pneumonia, endocarditis, empyema and arthritis, each in 2 cases; and meningitis, strangulated hernia, pyelonephritis, cerebral embolism and acute parotitis, each in one case. In four cases with a positive streptococcus blood culture, localized abscesses showed streptococci three times and staphylococci once.

The symptoms included fever, rapid pulse and prostration in every case. Chills were present in many of the fatal cases but showed no rule, and were often present in cases ending in recovery. A high temperature was a sign of the severity of the infection. About one-half of the cases had a temperature over 104° with a mortality of 66 per cent. Of the cases in which the temperature was generally below 104° the mortality was lower (about 45 per cent.).

The question as to operation, in septicæmia following abortion and labor, is unsettled. Murphy, De Lee, Watkins,[2] and others have strongly condemned operative interference in septic uteri. Hirst[3] in a questionaire sent to 273 authorities, including American and European surgeons and gynæcologists, found that while the majority (199) believed in cleaning out the uterus, a large number (74) believed in expectant treatment. It seems to be generally conceded, however, that after the uterus is once emptied it should be let alone and not reentered except for hemorrhage.

In the present series the operative procedures are conveniently divided, for purposes of study, into the early operations, performed either before or shortly after admission to the hospital, and the late operations, performed after the patient had been under observation long enough to determine whether the infection was stationary or progressive. The late operations were usually performed from 15 to 30 days after admission, during which time the patient usually showed some improvement followed by a period in which the symptoms remained stationary or grew gradually worse.

FINAL RESULTS OF EARLY OPERATIONS.

Operation.	No. of Cases.	Cured.	Died.	Result unknown.
Curettage	21	9	10	2
Laparotomy and drainage	4	1	3	0
Herniotomy and curettage	1	0	1	0
No operation	24	11	13	0

Many of the cases received the curettage before coming to the hospital. It is also probable that some of the cases under the head of "no operation" were curetted before admission although they gave no history of an operative procedure before coming to the hospital.

Operations later in the course of the illness were necessary in 12 cases. In 8 cases the late operation was performed after a preliminary curettage, tending to indicate that complications are more common after early operative interference. This is especially true of pelvic abscess which required drainage six times as often after curettage as after early expectant treatment.

LATE OPERATIONS FOLLOWING CURETTAGE.

	Cases.	Died.	Cured.
Laparotomy and drainage	5	2	3
Hysterectomy	1	1	0
Vaginal section	1	0	1
Thoracotomy	1	0	1

LATE OPERATIONS FOLLOWING EXPECTANT TREATMENT.

	Cases.	Died.	Cured.
Laparotomy and drainage	1	0	1
Vaginal section	1	0	1
Incision of abscess (not abdominal)	2	1	1

Owing to the uncertainty in the history of many patients, with reference to intra-uterine manipulations, it is difficult to form an estimate of the value of the two forms of early treatment. Ward, in giving the methods employed at the Sloane Hospital, outlines the treatment as follows: "If, despite the douches, the fever remains high . . . the interior of the uterus is explored. As far as possible all foreign material is removed, always with the idea of the minimum trauma, and a hot saline douche given. No packing or drainage is used unless hemorrhage occurs. . . . It should be said that if a post partum septic case is admitted to the hospital, this exploration takes place at once without waiting for the effect of vaginal and intra-uterine douches." Such procedure appears rational and sufficiently conservative to be in accord with the majority. To-day, there are few, if any, who believe in the more radical operations, such as hysterectomy and ligation of the pelvic veins, but the pendulum has swung so far in the opposite direction that many are urging absolute non-interference, even in cases in which the uterus is known to contain a large septic mass of retained secundines.

The treatment in all these cases was supportive and stimulating. Some of the cases were treated in the open-air with distinct benefit to the appetite and the nervous symptoms. Others received drugs directed toward both the symptoms and the general condition. The data as to the use of any special drug is too limited to admit of any conclusions.

Serum and vaccine treatments have been tried in a sufficiently large number of the cases to be of considerable interest. At present the use of vaccines and serum in puerperal sepsis is not on a firm basis. It is generally believed that serum does no harm and may do some good, and vaccines, while valuable in chronic processes, can have little influence, except a harmful one, upon an acute process. This despite some excellent clinical reports, especially from Western,[1] Wynn[4] and Rowlette,[5] in England, as well as Medalia and Watson,[6] Polak[7] and others in America.

Antistreptococcic serum or vaccines, or in some cases a combination of both, were administered in 17 cases, with 11 recoveries and 6 deaths, a mortality of 35 per cent., as compared with the mortality of the remaining cases (68 per cent.), nearly double that of the cases receiving specific treatment.

Antistreptococcic serum is bactericidal and consequently must be used early. If its administration is delayed until the bacteriological examination is made, much valuable time is lost and good results cannot be expected. A large percentage of the cases of puerperal sepsis is due to the streptococcus. Based on uterine cultures, this figure is variously given from 28 per cent. (Williams[8]) to 78 per cent. (Young and Williams[9]). The streptococcus plays a still larger rôle in the bacteriæmic cases. The following table gives the percentage of streptococci, staphylococci and other bacteria in cases of bacteriæmia:

	Total cases.	Bacteriæmia cases.	Streptococcus cases.	Staphylococcus cases.	Other bacteria.
Western	96	39	93 per cent.	5 per cent.	2 per cent.
Young and Williams	30	12	58 per cent.	17 per cent.	25 per cent.
Present series	50	22	82 per cent.	9 per cent.	9 per cent.

The paramount cause of puerperal septicæmia, according to Watson and Medalia, is the streptococcus, which occurs in

86 per cent. of cases. If then, the streptococcus is present in such a large percentage of the cases, and if we admit the bactericidal properties of antistreptococcic serum, it should be given to every case of puerperal sepsis without waiting for a bacteriological diagnosis.

The vaccine used depends upon the infecting organism and if, as is generally agreed, autogenous vaccines are the best, a certain definite time must elapse before the vaccine can be prepared and administered. During this period the use of stock vaccines has been advised. The reports in favor of vaccine treatment have already been referred to. In a report to the American Gynecological Association, Williams, Cragin, and Newell[10] say that little may be expected of vaccine treatment of puerperal sepsis; the most that can be said according to their report, is that vaccines do no harm. Theobald Smith[11] and Schwarz[12] hold somewhat similar opinions.

The results of the present series are distinctly favorable to both vaccine and serum therapy. In general, the mortality was lower in those cases where specific treatment was instituted; and the results seemed especially favorable when serum was given early followed by autogenous vaccine.

TABLE OF ALL CASES RECEIVING SPECIFIC THERAPY.

Treatment.	Cases.	Cured.	Died.
Serum alone	11	7	4 (36 per cent.)
Vaccine alone	3	2	1 (33 per cent.)
Serum and vaccine	3	2	1 (33 per cent.)

Reports of treatment of cases of proved bacteriæmia are even more favorable and indicate clearly the value of serum and vaccine therapy in severe blood infections. Of eleven cases treated by serum or vaccines 6 recovered and 5 died (mortality 46 per cent.). Of the six cured cases three received only serum, two received serum and vaccines and one was treated with vaccine alone.

It must not be argued against this series that the high mortality of the untreated cases is due to the inclusion of patients, moribund on admission, who died before vaccines could be administered. On the contrary most of the untreated fatal cases of bacteriæmia occurred before the general use of vaccines and were under observation for from five to twenty days (5, 6, 11, 19, and 20 days respectively), a sufficient time to have instituted both serum and vaccine treatment had such been deemed advisable.

COMPARATIVE TABLE SHOWING RESULTS OF TREATMENT OF BACTERIÆMIA.

	Total cases.	Specific treatment.		No specific treatment.	
		Cases.	Died.	Cases.	Died.
1. Streptococcus.					
Western	36	23	14 (61 per cent.)	13	12 (92 per cent.)
Wynn	..	6	1 (17 per cent.)		
Polak	..	28	6 (21 per cent.)		
Present series	17	11	5 (46 per cent.)	6	5 (83 per cent.)
2. Staphylococcus.					
Western	2	1	0	1	1
Polak	..	12	1 (8 per cent.)		
Present series	2	1	0	1	0

2. *Cases Following Infected Wounds and Abscesses.*—There were twenty cases in this group with a general mortality of 75 per cent. Most of the cases occurred during early adult life as follows: 10 to 20 two cases; 20 to 30 ten cases; 30 to 40 five cases; over 40 two cases. Eleven cases followed lesions of the extremities, five followed lesions about the head, two followed tonsillectomy, one case followed erysipelas and one followed appendix abscess. The blood cultures were positive in 14 cases (streptococcus 9 times and staphylococcus aureus 5 times); in 3 cases there was no growth; and in 3 cases cultures were not made. A local cellulitis was the most common complication, occurring in 15 cases. Suppurative arthritis occurred in 5 cases, bronchopneumonia in 4 cases, adenitis in 2 cases and furunculosis, pericarditis, endocarditis, lung abscess, brain abscess, perineal abscess and erysipelas each in 1 case.

The leucocyte count showed little of prognostic value. A moderate leucocytosis was the rule and very high or very low counts were the exception. On admission the counts of the cured cases were between 11,000 and 22,400 (average 15,600). Of the rapidly fatal cases the lowest count on admission was 6000 and the highest 36,000 average 20,600). No apparent difference could be made out between blood counts of the two types of bacteriæmia. The highest count obtained (50,000) was in a child 11 years old (case 52). This high count fell to 16,000 in four days together with improvement in general symptoms. Unfortunately after an afebrile period, an abscess of the brain developed which ended fatally on the fifty-sixth day.

The differential counts were not significant, the polynuclear cells varying between 72 and 91 per cent. in the fatal cases, and 73 and 89 per cent. in the cured cases. In general a leucocytosis with a moderate or marked increase of the polynuclear elements was the rule and of diagnostic significance. The absence of a leucocytosis, however, does not exclude the possibility of septicæmia.

The treatment consisted of incisions of local accumulations of pus wherever present, together with the usual supportive measures. There were fourteen cases with a positive blood culture, with three recoveries and eleven deaths (89 per cent.), four of which received vaccines with a mortality of only 25 per cent. The mortality of the untreated cases in this series was 100 per cent. Two cases received vaccines in combination with antistreptococcic serum, one of which recovered. One case recovered under treatment with autogenous streptococcic vaccines and one recovered under treatment with stock staphylococcic vaccine.

Table Showing Results of Vaccine Treatment in Bacteriæmia.

	Vaccines.		No vaccines.	
	Cases.	Died.	Cases.	Died.
Streptococcus	3	1	6	6
Staphylococcus	1	0	4	4
Totals	4	1*	10	10†

* 25 per cent. †100 per cent.

It should be stated that the one case (Case 52) dying under vaccine treatment showed marked improvement following the use of vaccines and serum, and died on the fifty-sixth day after an operation for brain abscess.

Does the vaccine treatment favor the localization of purulent foci? In each of the cases treated by vaccines in this series one or more operations were necessary late in the course of the disease for the relief of localized collections of pus. In two cases the knee was involved, in the third case one of the phalanges showed osteitis and required operation, and in the fourth case there was a brain abscess which finally caused death.

The results of vaccine treatment in this series may be said to have been decidedly favorable and to warrant further trial.

3. *Cases Following Osteomyelitis and Arthritis.*—Nine cases occurred in this group with seven fatalities. Unlike the two preceding groups these cases occurred most commonly during childhood and showed other variations to the types discussed above. The youngest patient was five years old and seven of the nine cases occurred before the twenty-first birthday. The other two occurred in patients 35 and 36 years respectively. Five cases began as a monarticular arthritis and four began as a frank osteomyelitis. The arthritis cases were frequently treated for days or weeks before admission to the hospital. Indeed, the diagnosis may be very difficult, as is shown by the records of one patient (Case 28) who was in the hospital 10 days before the diagnosis could be made.

The blood cultures, again in contra-distinction to the other groups, showed the staphylococcus to be the most common etiological agent. Of six cases in which the blood culture was positive, the staphylococcus was present four times, and the streptococcus twice. In 40 cases of staphylococcic bacteriæmia collected by Soper,[13] including the 4 cases in this series, osteomyelitis was present in 16 cases and suppurative arthritis in 10 cases.

The temperature in the two types of bacteriæmia showed some differences which were absent in the previous groups. In the streptococcus cases which were both rapidly fatal, the temperature was high, from 102° to 106°, while in the staphylococcus cases it was usually low, rarely going above 102°.

Bronchopneumonia was the most frequent complication, occurring in three cases; empyema and pyæmia each occurred in one case. Although five cases began as an apparent arthritis, practically every case showed osteitis in some form during the course of the disease.

The treatment of these cases consisted in operative procedures directed against the foci of infection and mechanical treatment for the inflamed joints, together with the usual supportive measures. Vaccines were used in four cases of staphylococcic bacteriæmia with two recoveries and two deaths, a mortality of 50 per cent. which compares favorably with the mortality of the entire series which was 78 per cent. In fact, as was the case in the preceding group, the only cases which recovered were those receiving vaccines.

4. *Cases Associated With Endocarditis and Pericarditis.*—For completeness these cases are included, for, while septicæmia is always present in malignant endocarditis, the condition is essentially different from the cases previously discussed and merits separate consideration. There were 16 cases, all showing a positive blood culture and all ending fatally. The results of the blood cultures were as follows:

Streptococci	12 cases
Streptococci and pneumococci	1 case
Staphylococci	2 cases
Meningococci	1 case

The disease was usually of long duration, many cases dying several months after the onset of symptoms. In a disease of such high mortality little can be learned from treatment. Five cases received vaccines, one received antistreptococcic serum and one received antimeningitis serum. The results were apparently nil. Wynn,[4] who has had remarkably good results in other types of bacteriæmia, has reported fifteen cases associated with endocarditis treated with vaccines with no recoveries.

5. *Miscellaneous Cases.*—Under this heading are included those cases which did not fall under the other headings. Of course cases where the blood culture gave evidence of a bacteri-

æmia which was part of the disease, as typhoid bacteriæmia in typhoid fever, were not included in this report. In a few the bacteriæmia was a complication to some other equally serious disease and little could have been expected from any plan of treatment. There were 16 cases with 11 deaths, and 4 recoveries and one case in which the final result is unknown. Infected uterine fibromata were the apparent cause of two cases, again emphasizing the rôle of the uterus in general blood infections. In two cases the septicæmia was apparently a complication of thrombophlebitis, making a total of nine cases in which the two conditions were associated. In three cases meningitis was complicated by bacteriæmia, one of which recovered. This case has been reported in detail by Bovaird[14] (Case 45). The following table shows the cases in which there were positive blood cultures:

Case No.	Complication.	Blood culture.	Specific treatment.	Result.
16	Infected fibroids....	Streptococcus	None	Died fourth day.
45	None............	Meningococcus	Serum	Cured.
48	Carcinoma,nephritis	Streptococcus	None	Died sixth day.
54	None............	Bacillus proteus vulgaris	None	Cured.
57	Phlebitis..........	Streptococcus	None	Died second day.
60	Phlebitis,pneumonia	Staphylococcus	None	Died nineteenth day.
105	Cholelithiasis......	Bacillus coli communis	None	Died nineteenth day.
107	Pyelonephritis.	Bacillus coli communis	None	Died fifth day.
108	Multiple arthritis..	Gonococcus	Vaccine	Died sixtieth day.
109	Meningitis	Pneumococcus	None	Died third day.
110	Meningitis	Streptococcus	None	Died fourth day.
111	Typhoid..........	Bacillus coli communis	None	Cured.

The two cases of infected fibroids died shortly after hysterectomy, one case showing a positive blood culture. In general, the results of treatment in these miscellaneous cases have been bad, possibly due in part to the severity of the complicating disease.

A table of all the cases having a positive blood culture has been prepared in order to show more clearly the results of treatment. For obvious reasons Group 4 has been excluded. The cases in Group 5 have already been tabulated and, as will be easily seen, are unsuitable for comparison with the first three groups.

There are included in the table 42 cases of proved bacteriæmia, in 41 of which the final outcome is known. Case

68 left the hospital on the fourteenth day, and may be disregarded in computing the averages of the results of treatment.

Cases Following Abortion and Labor.

Case No.	Apparent cause or associated lesion.	Temperature.	Blood culture.	Local culture.	Complications.	Specific treatment.	Result.	Day.	Remarks.
1	Abortion	H	Strep.	Staph.	Meningitis	None	D	5	Pneumococcus meningitis.
11	Abortion	..	B. aër. caps.	....	None	None	D	1	Culture made post mortem.
23	Abortion	M	Strep.	....	Pneumonia	Vaccine on tenth day	D	11	
26	Abortion	L	B. aër. caps.	B. aër. caps.	Nephritis	None	D	1	
30	Abortion	M	Strep.	....	Strang. hernia	Serum 100 c.c. on fifth day	D	6	
36	Abortion	H	Strep.	....	None	Serum on first day	D	6	
39	Abortion	H	Strep.	....	Pneumonia	Serum on fourth day	D	5	
62	Ante partum	M	Staph.	B. coli com.	Pyelitis	Vaccine bacillus coli	C	..	Abortion induced on 22nd day.
65	Post partum	M	Strep.	....	Phlebitis	Vaccines	C		
66	Post partum	M	Strep.	....	Phlebitis	None	D	11	
67	Post partum	H	Strep.	Strep.	Phlebitis	None	D	20	
68	Abortion	H	Strep.	....	None	Vaccine 1 dose	?		Left hospital 14th day.
70	Post partum	H	Strep.	....	Phlebitis	None	D	19	
81	Post partum	H	Strep.	Strep.	Endocarditis pyæmia	None	D	6	
82	Post partum	M	Strep.	Sterile	Pelvic abscess	Serum on first day	C		
83	Post partum	L	Staph.	....	Phlebitis, arthritis	Vaccine 2 doses	C		
85	Post partum	M	Strep.	....	Pyosalpinx	None	C		
86	Post partum	M	Strep.	....	Phlebitis, axillary abscess, arthritis	Serum on first day, vaccine on third day	C		
88	Abortion	H	Strep.	Staph.	None	Serum on first day, vaccine on second day	D	11	
90	Post partum	H	Strep.	....	None	Serum on fourth day	C		
92	Post partum	M	Strep.	Strep.	Pneumonia, empyema	Serum on first day	C		
95	Post partum	L	Strep.	....	Phlebitis	Serum on first day, vaccine on second day	C		

Of these 41 cases there were 14 recoveries and 27 deaths, a general mortality of 66 per cent. There were 28 cases of streptococcic bacteriæmia with 9 recoveries and 19 deaths.

CASES FOLLOWING INFECTED WOUNDS AND ABSCESSES.

Case No.	Apparent cause or associated lesion.	Temperature.	Blood culture.	Local culture.	Complications.	Specific treatment.	Result.	Day.	Remarks.
20	Cellulitis of face	H	Staph.	Staph.	None	None	D	2	
25	Infected wound	M	Staph.	Staph.	Arthritis	Vaccine on ninth day	D	11	
29	Infected wound	H	Strep.	Mixed	Abscess	Serum on eighth day	D	8	
31	Infected wound	H	Strep.	Mixed	Cellulitis	None	D	10	
33	Carbuncle	H	Staph.	Staph.	Osteomyelitis	Stock vaccine	C		
34	Furunculosis	L	Staph.	Staph.	Nephritis	None	D	5	
44	Infected wound	H	Strep.	Staph.	Cellulitis, pneumonia	Vaccine	C		
46	Infected wound	H	Strep.	Strep.	Cellulitis, pneumonia	None	D	13	
49	Tonsillectomy	H	Strep.	Mixed	Abscess of lung, pneumonia	None	D	5	
52	Infected wound	H	Strep.	....	Brain abscess	Serum for eight days, vaccine on eighth day	D	56	Craniotomy on fifty-fifth day.
53	Erysipelas	H	Staph. aureus	....	Erysipelas	None	D	2	
55	Infected wound	H	Strep.	....	Perineal abscess	None	D	8	
56	Infected bunion	M	Strep.	....	Endocarditis, arthritis	None	D	4	
80	Tonsillitis, abscess neck	H	Strep.	Strep.	Arthritis, cerv. abscess of knee	Serum on first day, vaccine on fifth day	C		

CASES FOLLOWING OSTEOMYELITIS AND ARTHRITIS.

Case No.	Apparent cause or associated lesion.	Temperature.	Blood culture.	Local culture.	Complications.	Specific treatment.	Result.	Day.	Remarks.
15	Osteomyelitis	H	Strep.	Mixed	None	None	D	2	
18	Osteomyelitis	L	Staph.	Staph.	Pneumonia, empyema	Vaccine 2 doses	D	14	
22	Osteomyelitis	L	Staph.	Staph.	None	Vaccines on eighth day	C		
24	Osteomyelitis	M	Staph.	Staph.	Pyæmia	Vaccines	D	28	
28	Arthritis	L	Staph.	Staph.	Osteomyelitis	Vaccines	C		
32	Arthritis	H	Strep.	....	None	None	D	3	

Tables showing all cases in which the blood cultures were positive.

Temp: H = temp. over 104°; M = temp. 102°–104°, L = temp. below 102°. Result: D = died, C = recovered, ? = termination unknown. Day: Number signifies days after admission to hospital. Specific Treatment: refers to vaccine or serum therapy and day of beginning treatment.

Of the 9 cured cases *every case but one* was treated with either vaccines or serums. On the other hand, there were two cases treated with vaccines which ended fatally (Cases 23 and 52); one of these cases received only one dose of vaccine and the other was the case already mentioned which died after operation from brain abscess. The first of these failures cannot speak against vaccine therapy and the effect of the vaccine on the general septicæmia in case 52 was all that could be wished.

Serum alone was given in 7 cases of streptococcic bacteriæmia with three recoveries and four deaths. The writer believes that in some cases the serum was given so late and in such small doses that little could have been expected. Cases rarely reacted favorably to less than 40 c.c. daily and some cases received 100 c.c. or more at a single dose. It may be noted here that antistreptococcic serum loses its complement after it has been kept for some time and when the fresh serum is not obtainable a certain amount of fresh horse serum should be added to each dose.[15] It is said that fresh horse serum complement is better adapted to the antistreptococcic serum than is human complement. The commercial polyvalent serum was used, except in a few of the recent cases in which the serum supplied by the New York City Board of Health was used. Apparently the results in the more recent cases were a little better than the earlier results, either because the serum was fresher, or because of the difference in the character of the serum. Vaccines, either alone or in combination with antistreptococcic serum, were given 7 cases of streptococcus bacteriæmia with 5 recoveries and 2 deaths. Among similar cases, receiving no specific treatment, there were 13 deaths and only one recovery.

Of the staphylococcus cases there were 11 cases and 6 deaths, a general mortality of 55 per cent. Of the cases treated with vaccines there were 4 recoveries and 3 deaths. Among the untreated cases there was only one recovery. This case (No. 62) was treated with colon bacillus vaccine for pyelitis complicating pregnancy, during the course of which she developed a staphylococcus bacteriæmia. Following an induced abortion both conditions improved. In discussing the use of vaccines in the treatment of bacteriæmia such a case should properly be included among the cases *not* receiving vaccines. The case receiving the stock staphylococcus vaccines (Case 33) left the hospital on the tenth day and received the vaccines while under the care of his own physician. It is included here because the diagnosis is certain, his condition was extremely grave, and a decidedly bad prognosis was given when he left the hospital. In all the staphylococcus cases the staphylococcus aureus was the organism isolated.

Two positive cases of bacillus aërogenes capsulatus bacteriæmia occurred, both coming to a fatal issue within twenty-four hours.

The following table gives at a glance the results of the different methods of treatment:

		Cured.	Died.
Streptococcus, (28 cases)	Vaccine treatment	5	2
	Serum treatment	3	4
	No specific treatment	1	13
Staphylococcus, (11 cases)	Vaccine treatment	4	3
	No specific treatment	1	3
Bacillus aërogenes capsulatus (2 cases)		0	2
	Total	14	27

Reference should be made here to some of the other methods of treating septicæmia which are advised and which have been used to a considerable extent. Cheyne[16] advises quinine in full doses, together with polyvalent antistreptococcus serum. Watkins[2] and Young and Williams[9] advise out-door treatment. Lobenstine[17] has reported the use of intravenous infusions of magnesium sulphate in one case with success. A few years ago formalin was used in some infections of this type, but it was soon discarded as useless.

Credé[18] gives from 2 to 10 c.c. of a two per cent. solution of collargol intravenously. This drug has been quite extensively used, but there is little reference to it in the recent literature except by Wolf,[19] who reports one case cured by means of collargol enemata. Its value is problematic. More recently, especially in Italy and France, considerable praise has been given to mercury in the treatment of general sepsis (Girou,[20] Schmidlechner,[21] Stowe[22]). In the few cases I have found in which a proved bacteriæmia was present, the results have been bad. Schmidlechner reports six cases of streptococcic bacteriæmia treated with mercury in which there was only one recovery.

In all of these methods the object has been the sterilization of the blood by the use of drugs, the so-called chemicotherapy, in contradistinction to the conquest of the infection by methods designed to increase the resistance of the patient, immunotherapy. While the results of the drug treatment of bacteriæmia have been disappointing heretofore, the remarkable success of Ehrlich's salvarsan in the treatment of syphilis, gives promise of a similar therapy for other general infections.

CONCLUSIONS.

1. Septicæmia with true bacteriæmia is a disease of great severity and of exceedingly high mortality, but, except in the type associated with malignant endocarditis, and in terminal infections, many cases are amenable to treatment.

2. Vaccines are of benefit in many of the cases not overwhelmed at the onset by the severity of the infection, and, clinically, seem to benefit the majority of the cases.

3. Antistreptococcic serum is of great value, especially during the early stage when its bactericidal powers are most pronounced, and if given in sufficient dosage during the period of invasion will often change a systemic bacteriæmia into a localized infection.

4. The combination of antistreptococcic serum, used in the early stage of septicæmia, together with autogenous vaccines, used as soon as they can be prepared from blood cultures, seems to be particularly beneficial. If the bood cultures are sterile, vaccines may be prepared from the local lesion, although this method is unsatisfactory and may lead to errors. Stock vaccines are still less desirable, and are of uncertain value.

5. Neither sera nor vaccines, although they usually do little harm, are free from danger, and the dosage and intervals need to be carefully worked out.

6. Open-air treatment in cases in which cultures are sterile and as an adjunct to vaccine and serum therapy seems to be the best method of increasing the resistance of the patient.

NOTE.—I desire to express my thanks to the attending staff of the Presbyterian Hospital for permission to publish these reports and especially to Dr. Ellsworth Eliot, Jr., for his advice and criticism in the preparation of this paper.

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THE ADVANTAGES OF THE DOUBLE RESECTION IN CERTAIN TYPES OF GOITER.

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(From the Mayo Clinic.)

The surgery of the non-toxic and non-malignant enlarged thyroid at the present time is attended by practically no mortality. That this fact is known to the laity is evidenced by the increasing frequency of operations on the thyroid by surgeons who are attaining good results, both immediate and ultimate. Realizing, then, that the development of the operative treatment of the thyroid has made safe, in so far as life is concerned, the removal of the so-called simple goiter, further advancement must be made in refinement of technic, in lessening the possibilities of complications, in improving the end-results, and in obviating, as much as possible, recurrence of the condition.

Patients with thyroid enlargement without any evidence of toxæmia attributable to the goiter usually desire its removal only for mechanical and cosmetic reasons—that is, pressure and deformity. It is in this group that not only is safety imperative, but also an operation which will offer the patient the greatest probability of permanent relief. With this in mind, I wish to describe a type of operation which, while not original in this clinic—it being but a modification of the Mikulicz resection—is being used more and more frequently and with most satisfactory results. The operation is performed as follows:

The usual low-collar incision is made, the external jugular vein marking the limits of the incision laterally. The subcutaneous tissue and platysma are then reflected, the upper flap as high as the thyroid cartilage, the lower flap to the sternal notch. The vertical muscles, sternohyoid and sternothyroid of one side are then separated from those of the opposite side by dividing in the midline, from the thyroid cartilage to just above the sternal notch. The thin peritoneum-like fibrous covering of the gland will then be exposed and this should be freed over the front of both lobes.

The finger is then inserted under this capsule and the entire gland carefully explored to determine the size of the lobes, the relations of the trachea, and the presence of any substernal, retrotracheal or other isolated portion of gland.

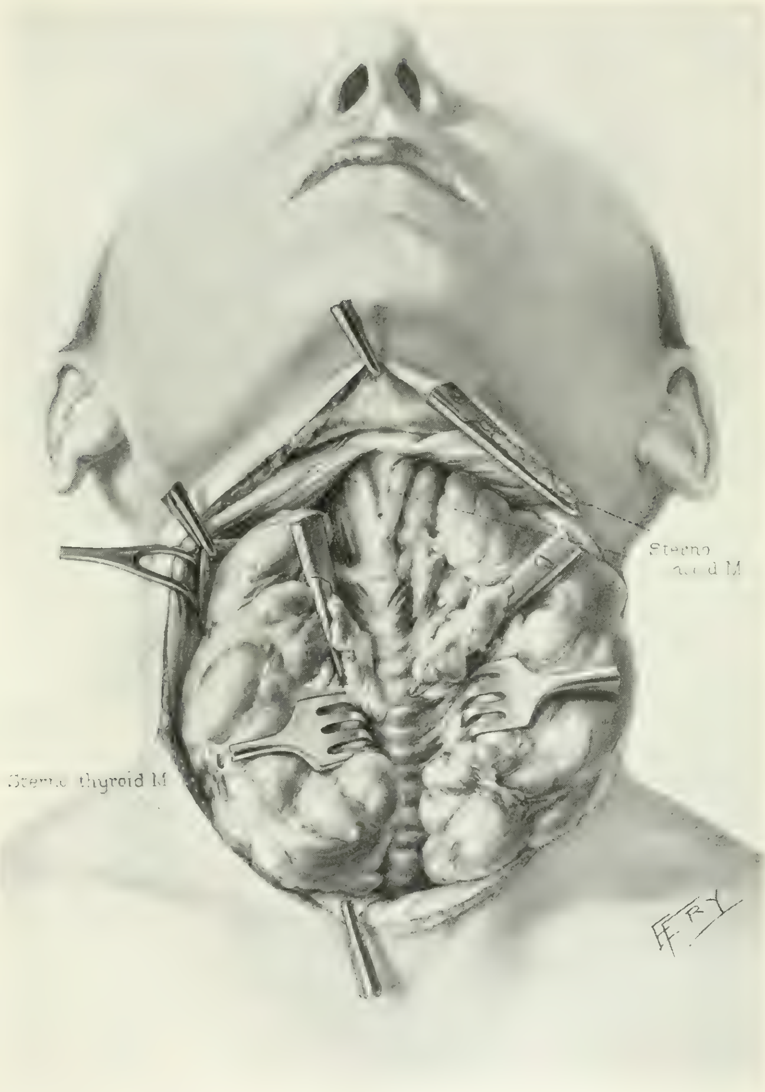
It is now possible to decide upon what should be the further operative procedure. If the exploration reveals a single encapsulated adenoma or cyst in one lobe with an apparently normal lobe on the opposite side, extirpation of the involved lobe or enucleation of the tumor with division of the isthmus is usually sufficient. If, however, as is so much more frequently found, both lobes are involved in the same process, that is, a diffuse colloid condition, or multiple adenomata of various sizes, we believe the removal of the diseased portion of each lobe is the operation of choice. As a preliminary step, it is often possible to dislocate both lobes from their positions by careful finger-manipulation, after freeing any lateral or accessory veins. In this manner the entire gland in many cases can be traced to a situation as shown in Fig. 1.

It is immediately obvious in a large percentage of cases that removal of the larger lobe will be inefficient in relieving both pressure and deformity, and offers considerable possibility of recurrence of the trouble not only by later enlargement of the remaining lobe, but also because of the retraction beyond even the natural contour of the normal neck which may take place on the side from which the lobe has been removed. A double resection, therefore, in this group of cases seems to be the ideal procedure and is being more and more frequently employed by us. During 1913, of 1569 operations on patients with various types of goiters, 783 were of the non-toxic or non-exophthalmic type, 583 of which were for so-called multiple or diffuse colloid adenomas. In this latter group of patients, 295, or 55 per cent., were operated on by the double resection method, 116 (21.7 per cent.) had an extirpation of one lobe and isthmus, 122 (23 per cent.) had extirpation of one lobe, isthmus and part of the other lobe.

Both lobes are dislocated if possible. In doing this completely one often finds that one or both lobes have a tendency to become flattened out and extend behind the trachea so that this structure is frequently entirely surrounded by the thyroid tissue. By careful traction the entire lobe of each side can be exposed, and by inspection it can be determined what portion of each should be removed in order to obtain a good end-result.

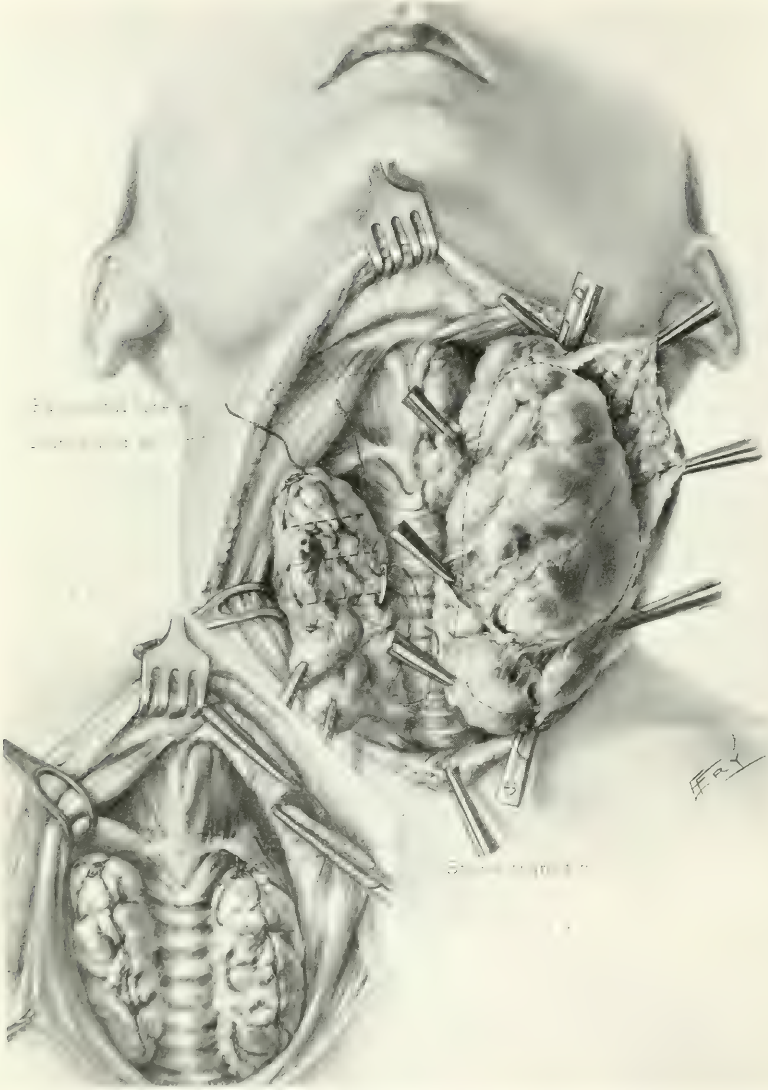
The first step in the actual removal consists of a division of the isthmus. This in some cases entails considerable oozing, especially when the structure is of any thickness, but in the majority of cases, if the operation is done with care and an effort made to find the narrowest part, little difficulty will be encountered. In some cases the isthmus can be lifted from the trachea, two forceps clamped entirely across, and complete division made between these. The segment of isthmus of one side is then freed from any further attachment to the trachea and by steady traction and careful dissection the lobe on that side is freed from the trachea anteriorly and laterally sufficiently to relieve all pressure and to permit of satisfactory suturing after the resection. The other half of isthmus and the opposite lobe are then freed in the same way, disclosing the arrangement of the parts shown in Fig. 2.

Fig. 1.



Both lobes have been freed from their accessory veins and the isthmus divided between forceps.

FIG. 2.



a (left lobe), shows controlling forceps placed and resection of lobe begun. Right lobe resected, with running mattress suture being placed. *b*, shows the relationship of the built-up remnants of the gland.

Either lobe is now resected. The following has been found a convenient and safe method. A series of Ochsner forceps are applied somewhat as follows: One at the superior pole, as a rule about an inch from the upper extremity, one at the inferior pole, three or four laterally, placed on the larger vessels in the capsule and two or three on the tracheal side. These forceps appropriately placed serve the joint purpose of marking the limitations of the resection and of enabling one to control hemorrhage by traction on them along with support of the lobe from behind with the finger. The lobe is then encircled with an incision through the capsule just above the forceps. The resection is then made by "wedging" out the interior of the gland. In practically all multiple adenomas the colloid masses will separate easily from the healthy gland by finger enucleation. In the diffuse colloid glands without tumors the proper portion to resect is readily determined. Having completed this there will be remaining the superior pole, the entire posterior capsule with a layer of gland-tissue and oftentimes the inferior pole, so that the portion of the gland most closely approaching the normal has been retained. This cup-shaped structure is now rebuilt into a compact strip of gland-tissue by suture. We have found the following method of suturing very satisfactory: Starting at either pole, a continuous mattress suture of plain catgut from outer to inner capsule is inserted behind the line of forceps originally placed on the capsule and continued to the other extremity of the lobe. This controls practically all the bleeding and obliterates the cavity in the centre of the lobe. The same suture, returning in an opposite direction, by a locking or button-hole stitch catches the edge of the capsule and rolls the two edges together into some semblance to a normal lobe. This reconstructed lobe is then allowed to drop back into the space formerly occupied by the enlarged gland. The opposite side is treated in the same way, resecting as much as seems necessary.

The proper amount of thyroid to be left cannot be stated in actual figures. In no case in which this method of resection has been used has there been any evidence of too much thyroid having been removed.

The difficulties of this type of operation become less with increasing experience, and I believe are more than compensated for by the distinct advantages obtained. In the first place, the operation is eminently safe in all respects. Control of hemorrhage is more certain, if possible, by suture than by ligature. Danger of injury to the recurrent laryngeal nerve is greatly minimized and can hardly occur if the operation is properly performed. Free dissection of the gland from the trachea is permissible and gives an opportunity for much easier and efficient control of bleeding by suturing from internal to external capsule. The fact that the superior and inferior poles and the entire posterior part of capsule are retained precludes any possibility of removal, injury or interference with the circulation of the parathyroids. This operation is of particular value in treating large goiters which by long continued pressure on the trachea have caused a softening of the rings. In these cases a temporary tracheal collapse sometimes occurs when the pressure on one side is relieved and the surgeon is in an awkward predicament under such circumstances, if the trachea is not quickly available. By this method the exposure of the trachea as a first step gives immediate and continuous control of the situation.

The benefits to the patient from this type of operation are well defined. All sense of pressure is relieved, and the neck is made quite symmetrical, which cannot be said of some of the cases in which an entire lobe has been removed and the opposite lobe left untouched. After such an operation one can assure the patient that there will be much less liability of recurrence of the goiter than with any other type of operation.

The cases to which this operation is applicable are in general the diffuse colloid adenomas. It is not necessary, of course, in the single cystic thyroid, where the trouble is due to an isolated tumor in the gland. It has a very limited field in the exophthalmic group where symmetry is a secondary consideration and the patient is operated for relief of symptoms only.

THE FREQUENCY OF CARCINOMA OF THE APPENDIX.

A REPORT OF 40 CASES (.44 PER CENT.) IN 8039 SPECIMENS.

BY WM. CARPENTER MacCARTY, M.D.,

AND

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(From the Mayo Clinic.)

THE frequency with which carcinoma of the appendix occurred in the surgical material of the Mayo Clinic during a routine examination of appendices which had been removed primarily or secondarily has stimulated the writers to investigate further the regularity and frequency of its occurrence. In a previous report[1] 22 specimens which presented histological pictures of carcinoma occur in 5000 specimens. Only five of these were large enough to be suspected at operation. The remaining 17 were discovered only upon making routine gross serial sections. The neoplasm was not visible upon the external surface and occurred always in appendices in which the lumen had been partially or completely obliterated.

In the published series the condition occurred in the following frequency:

5 (½ per cent.) in the first 1000.
7 (7/10 per cent.) in the second 1000.
3 (3/10 per cent.) in the third 1000.
2 (2/10 per cent.) in the fourth 1000.
5 (½ per cent.) in the fifth 1000.

The youngest (five years) occurred in a female who was operated upon for appendicitis. The average age was thirty

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[1] MacCarty and McGrath: Clinical and Pathological Significance of Obliteration, Carcinoma and Diverticulum of the Appendix. Surgery, Gynæcology and Obstetrics, March, 1911.

TABLE OF CASES.

Hosp. No.	Age.	Sex.	Duration of symptoms.	Location of pain.	Fever.	Vomiting.	Jaundice.	Condition found.
280[illegible]	26	F	4 yrs.	Rt. iliac region	+			Chronic appendicitis.
28350	50	F	15 yrs.	Umbilical region, rt. iliac region				Chronic appendicitis. Tumor on end of appendix carcinoma.
26527	25	F	4 yrs. 3 yrs.	Epigastrium Rt. iliac region				Chronic cystic appendicitis.
18030	33	M	2 yrs.	Abdomen (gen.), rt. iliac region	+	+		Cirrhosis of liver. Carcinoma at base of appendix.
17259	20	F	Several yrs.	Rt. iliac region				Subacute appendicitis. Carcinoma of tip of appendix.
31005	23	F	8 yrs.	Rt. iliac region to back				Chronic appendicitis.
25862	30	M	1 yr.	Abdomen (gen.), rt. iliac region	+	+		Chronic appendicitis.
31023	37	F	4 yrs.	Umbilical region, rt. iliac region	+	+		Chronic appendicitis. Gall-bladder thickened.
31326	26	F	8 yrs.	Rt. hypochondrium, rt. iliac region	+	+		Chronic appendicitis.
31679	5	F	Since birth			+		Chronic appendicitis. Enlarged glands in the mesentery.
32898	22	F	8 mos.	Rt. iliac region	+	+		Chronic appendicitis.
29613	27	F	7 wks.	Rt. iliac region, rt. hypochondrium			+	Chronic appendicitis (adherent).
24497	42	M	3 mos.	Epigastrium				Right inguinal hernia. Chronic appendicitis.
34532	80	M	10 yrs.					Four stones in urinary bladder.
A33079		F						Subacute appendicitis. Cholelithiasis.
32682	34	F	4 mos.	Rt. iliac region		+		Endometritis and uterine fibroids. Appendicitis, Carcinoma of the tip of the appendix.
31580	16	F	2 yrs. 10 das.	Rt. iliac region Rt. iliac region	+			Acute appendicitis.
21362	29	M	11 yrs.	Rt. iliac region	+	+		Acute appendicitis. Small abscess in omentum.
23043	26	F	2 yrs.	Rt. hypochondrium		+	+	
*Carc. A								
*Carc. B								
*Carc. C								

*Labels blurred or lost.

43694	22	F	6 mos.	Epigastrium				Carcinoma of appendix.
43933	44	M	15 yrs.	Epigastrium				Chronic catarrhal cholecystitis. Chronic pericholecystitis. Chronic catarrhal appendicitis with stenosis of canal in distal one-third. Carcinoma at tip.
44138	10	M	9 mo.	Lower lt. quadrant			+	Chronic catarrhal appendicitis with carcinoma developing on area of stenosis at middle and causing atresia of canal.
44170	37	F	5 yrs.	Lower abdomen				Bilateral chronic suppurative salpingo-oöphoritis. Very early carcinoma of appendix.
44255	36	F	5 yrs.	Epigastrium, rt. iliac fossa				Colloid carcinoma of appendix.
44537	27	F	11 yrs.	Epigastrium			+	Adenomyoma of uterus. Chronic catarrhal appendicitis with carcinoma at tip.
45406	31	F	11 yrs.	Epigastrium		+		Carcinoma of appendix. Chronic catarrhal cholecystitis. Cholelithiasis.
45446	39	F	8 yrs.	Rt. iliac fossa				Carcinoma of appendix. Umbilical hernia.
47148	22	M	2 yrs.	Rt. iliac fossa				Chronic catarrhal appendicitis with carcinoma at tip.
48430	17	F	8½ mos.	Rt. iliac fossa		+		Carcinoma. Chronic catarrhal appendicitis with obliteration of distal one-third.
48974	27	M	4 yrs.	Epigastrium				Carcinoma 5 mm. from tip of appendix.
49974	30	M	7 yrs.	Epigastrium				Chronic catarrhal appendicitis with carcinoma at tip.
49976	28	F	3 yrs.	Rt. iliac fossa		+	+	Small hemorrhagic fibromyoma. Chronic catarrhal appendicitis with carcinoma at tip.
50920	10	F	4 yrs.	Rt. iliac fossa	+			Chronic catarrhal appendicitis with carcinoma at tip.
51904	34	M	4 das.	Under rt. costal arch		+		Carcinoma.
52076	32	F	2 mos.	Rt. iliac fossa				Bilateral chronic salpingitis and oöphoritis. Carcinoma of appendix.
53526	26	F	19 yrs.	Abdomen		+		Carcinoma of distal end and pigmentation of mucosa of proximal one-half.
54098	44	F	7 mos.	Rt. of umbilicus				Bilateral chronic salpingitis. Simple ovarian cyst. Chronic catarrhal appendicitis with obliteration of mucosa at tip. Carcinoma at tip.

years. Seventy-three per cent. were females. Ninety per cent. occurred near the tip of the appendix.

It was found that the average duration of symptoms was 3.3 years. One in every 225 of all appendices in the series and one in every 53 partially or completely obliterated appendices were carcinomatous. Thirty-one per cent. was found in association with other abdominal and pelvic conditions.

Since these findings were made, 3039 specimens which were removed between November 15, 1911, and July 1, 1913, have been examined immediately upon removal. In this later series 18 (6/10 per cent.) were carcinomatous. In all specimens the lesion occurred at or near the tip and in a portion, the lumen of which had been obliterated. In none of these was there any gross evidence of the condition at operation. The findings were only made upon careful examination in the surgical laboratory. The lesion itself consisted of islands or masses of epithelial cells, which were scattered throughout the submucosa, muscularis and subserosa (Figs. 1 and 2).

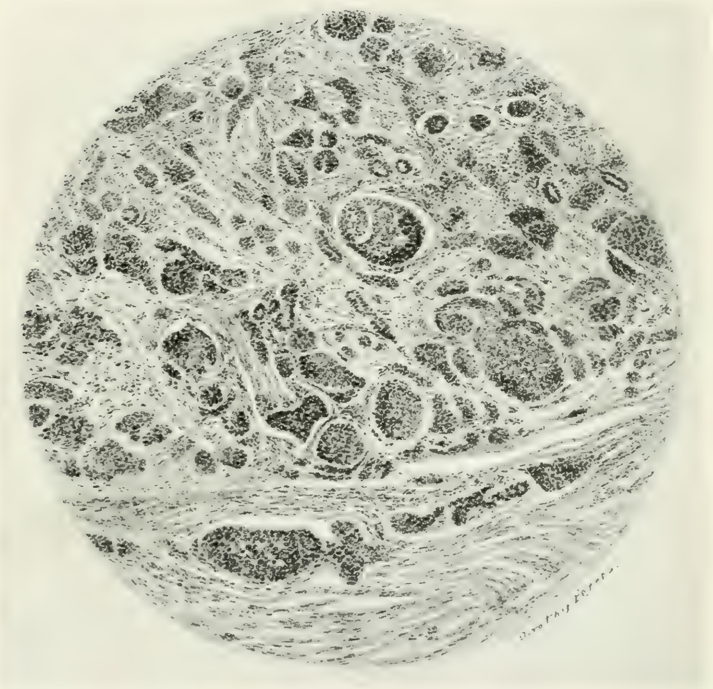
The nuclei presented the irregularities which are characteristic of carcinomatous cells (Fig. 2).

The present interest which stimulated this report rests upon a desire on the part of the investigators to learn something about the clinical significance of the condition.

In none of the cases herewith presented was there any fact which pointed to clinical importance. However, the mere fact that such a condition is comparatively frequent and, indeed, rather a constant finding is significant enough to warrant closer study of the appendix in view of the possibility of more extensive changes.

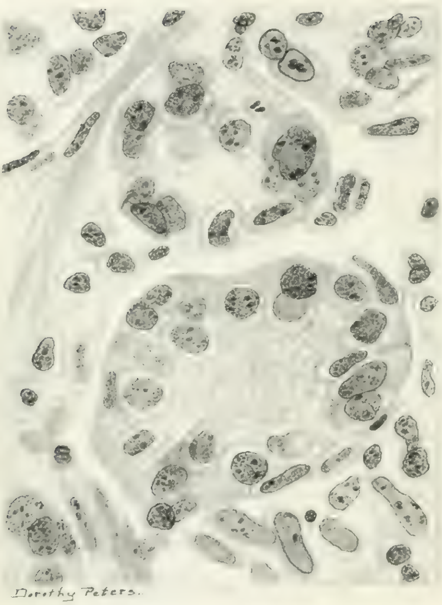
Surgeons and pathologists are therefore urged to closely examine all such cases and note the presence of metastases if such occur.

FIG. 1.



No. 31005. Involvement of the submucosa and the musculature by carcinoma.

FIG. 2.



No. 31005. Showing the irregular character of the nuclei in early carcinoma of the appendix.

A CONSIDERATION OF CERTAIN COEXISTING LESIONS OF THE GALL-BLADDER AND KIDNEY.*

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THE clinical features of a given lesion vary least in uncomplicated lesions of single organs. While, even in cases of this kind, the symptoms may prove so exceptional as to make diagnosis difficult, this difficulty is still further increased and becomes more common when more than one organ is involved. If, in this way, the lesion is multiple, a distinction must be made between those cases in which other organs gradually become involved by an extension of the primary lesion, as for example, the metastases of malignant growths, those cases in which multiple lesions, occurring simultaneously or in sequence but independently, are probably due to a common cause or diathesis, as for example, certain multiple benign neoplasms such as lipoma, those cases in which the lesions as well as their associated clinical features are considerably modified either by the consecutive development or by the coexistence of two or more individual agents of infection, and finally, those cases in which the actual diagnosis is greatly obscured by the coexistence of two or more entirely separate and independent lesions in organs lying in juxtaposition, in any one of which, when occurring singly, no special difficulty in diagnosis would be encountered.

In cases of multiple lesions in which secondary lesions develop, or in those cases in which all lesions irrespective of the time of their appearance, may be ascribed to a common cause, clinical observation and research, extended over many centuries, has standardized and facilitated the methods of diagnosis and has diminished the frequency of error. On the other hand, the study of the modification of any special lesion by either some form of pre-existing infection or *vice versa,* is still in a stage of early investigation. Thus, for example, what change if any could be expected in tubercular cervical lymph-nodes in the event of syphilitic infection, or does syphilitic infection modify either the lesion or the clinical course of pre-existing malignant disease?

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* Read before the New York Surgical Society, January 14, 1914.

It is, however, to the last group of cases, in which the diagnosis is obscured by the coexistence of two or more entirely distinct lesions in adjacent organs, that the writer wishes to call attention and as the field is necessarily a broad one, the scope of inquiry will be limited to the consideration of coexisting lesions of the right kidney and gall-bladder.

Coexisting lesions of these organs, the result of trauma, are necessarily simultaneous. This is equally true of subcutaneous rupture as well as of penetrating wounds. In cases of the latter character the clinical picture is of interest in that symptoms arising from injury to one viscus may be partially or completely obscured by those arising from injury to the other. The uncertainty of diagnosis may be still further increased by the involvement of additional adjacent viscera and the actual nature and extent of the injuries may be ascertained only after making an exploratory incision. In the case of the kidney, while subcutaneous rupture is usually limited to that organ, its close relation to adjacent viscera accounts for the fact that, in penetrating wounds, one or more of these structures are injured as well. In a careful search of the literature 25 cases of pistol shot wound of the kidney were collected in a majority of which some additional viscus had been torn or penetrated. These included the pleura and diaphragm, the cardiac end and other parts of the stomach, the duodenum, the ileum, the colon, the splenic vessels and of the solid viscera, the pancreas and the liver. That the gall-bladder ordinarily escapes is not surprising in view of its protection by the liver, the costal margin, its considerable mobility, and its usually flaccid condition. While several cases of penetrating wound of the gall-bladder have been reported, no mention of a simultaneous penetration of this organ and of the right kidney has been made.

In the case herewith reported there was no suspicion of damage to the gall-bladder prior to the discovery of a large amount of bile in the peritoneal cavity. Examination then showed two orifices near its fundus through which the bullet had entered and had left that viscus. On the other hand, the previous withdrawal of blood and urine through the catheter indicated a laceration of some part of the urinary tract above the bladder, and further search disclosed an extensively torn right kidney invested in a large retroperitoneal hæmatoma. The subsequent careful routine examination, so important in all penetrating wounds of the abdomen, revealed only a grazing of the hepatic flexure of the colon without penetration of its cavity.

The treatment of penetrating wounds of the kidney has been both conservative and radical. Of the sixteen cases reported by Clémens three were treated expectantly with one recovery and two deaths. In the case that recovered the diagnosis was made by the presence of a punctured wound in the lumbar region associated with hæmaturia; in the two cases that died the damaged kidney was found on autopsy. In one of these cases the peritoneal cavity was found filled with clots, death having followed a sudden effort three days after the injury had been received, during which time the patient's general condition had been excellent. This same clinical course has occurred in rupture of other viscera, notably of the liver and spleen and one instance of rupture of the ileum without hemorrhage was reported by the writer some years ago. Such unfortunate accidents in connection with traumatic conditions of the abdomen point very strongly the moral that immediate exploration is warranted when the physical signs indicate the possibility of rupture, even though the general condition of the patient is such as not to excite apprehension.

Of the remaining 13 cases five were treated by tampon, in three of which the kidney perforation was the sole lesion;

while in the remaining two, one was complicated by a wound of the diaphragm and pleura and the other by two perforations of the duodenum and ileum which were sutured. All five cases recovered. In two other cases the kidney laceration was treated by suture. Both of these were complicated by a wound of the liver and in one the colon was perforated as well. The last mentioned case recovered, the former died. The remaining 6 cases were treated by nephrectomy: of these, two were without complications, with one recovery and one death, and four were complicated with wounds or perforations of other viscera. Of these, two recovered and two died. Taking the 16 cases together, 10 recovered and 6 died, recovery being largely favored by prompt interference.

While the total number of cases is entirely inadequate to serve as a basis for the formulation of the most desirable method of treatment, the advisability of exploration should at least be emphasized. If the bullet has entered the anterior abdominal wall this warning, for reasons already stated, is superfluous. In no instance would conservatism be warranted. If, on the other hand, the bullet has penetrated the lumbar region, the exposure of the kidney can be made with little risk and can be followed by nephrectomy when the kidney tissue or its pedicle is badly torn, or by tampon or suture when the laceration is not extensive. The ascending colon can then be examined and any perforation, if such exist, may be closed. If the bullet has penetrated the peritoneal cavity, further exploration and all necessary treatment is preferably made through an anterior incision.

In a search of the literature no cases of coexisting penetrating wounds of the gall-bladder and kidney were found. Two cases, however, have been reported by Frank and Wiewiorwoski respectively, in which the gall-bladder had been penetrated by a bullet. In Frank's case no other lesion was found, while in Wiewiorwoski's case there was, in addition, an orifice in and near the anterior border of the liver. Both of these cases are of interest in that they show that pronounced symptoms may be expected in penetrating wounds of the gall-bladder even though no other viscus is involved and they illustrate as well an interesting method of dealing with the perforation. Brief abstracts of these cases follow.

Frank's Case.—Location of wound one and a half inches below and one inch to the right of the ensiform. Bullet felt under the skin opposite the middle of the eleventh rib which it had fractured. The patient was in moderate collapse and had several attacks of hæmatemesis. The peritoneal cavity opened through a three inch vertical incision just to the left of the median line, and was filled with blood which seemed to come especially from the region of the gall-bladder. This organ was situated nearer than usual to the median line and presented in the line of the incision. A perforation near its fundus, bleeding freely, was closed with silk and reinforced with Lembert sutures. After the removal of the blood the abdomen was closed without drainage. Recovery.

Wiewiorwoski's Case.—Location of the wound beneath the costal margin in the mammary line. The symptoms included pain, rigidity, weak pulse and shallow respiration. Peritoneal cavity opened 7 hours after the accident contained much bile. A hole 3 cm. from the anterior border of the liver and a large perforation on the under side of the gall-bladder were closed, each with two sutures. Drainage for 8 days. Wound completely healed on the twelfth day. Recovery.

The closure of the perforation in both cases is in marked contrast to the cholecystectomy which treatment was adopted by the writer. In the case herewith reported the two openings in the fundus of the bladder were about one inch apart and could have been separately sutured or a satisfactory cholecystostomy could have been easily established. Which method of treatment is preferable cannot be determined, but at all events it is well to remember that if the condition of the patient requires haste, the simple closure of the perforation has given satisfactory results.

The report of the writer's case herewith follows with mere mention of the fact that there were no symptoms prior to the opening of the peritoneal cavity that suggested the damage to the gall-bladder. The symptoms of peritoneal irritation would naturally appear after any penetration of that cavity with no visceral involvement.

Male, twenty-five. Shot at 4 A.M. with a pistol of medium calibre, and brought to the Gouverneur Hospital. Examination revealed a small circular orifice in the upper right quadrant about one inch below the costal margin near the outer margin of the rectus muscle. There was marked hæmaturia together with the symptoms of peritoneal irritation both anteriorly and in the right flank. Four hours afterward, an opening along the margin of the right rectus disclosed a large amount of bile in the peritoneal cavity. The gall-bladder was very small, of healthy appearance, and presented near its fundus two openings through which the bullet had passed. The hepatic flexure of the colon was grazed. The right kidney was extensively lacerated and bleeding into both the peritoneal cavity and the retroperitoneal space. The gall-bladder and right kidney were removed and the abdomen closed tightly around a cigarette drain. Convalescence was complicated by suppuration in the perinephritic tissue which quickly yielded to a counteropening. Three years after the accident, the patient was in excellent condition.

Since the publication of Clémens' article, cases have been reported, several rather incompletely, by Wilson, Thorne, Walker, Küster, and Keuper. In Wilson's report of 26 cases of gun-shot wounds of the abdomen, the kidney was injured in one instance, recovery ensuing. In Thorne's case the bullet entering anteriorly, penetrated the greater curvature of the stomach and the upper pole of the left kidney. The perforation of the stomach was closed and the peritoneum over the damaged kidney was sutured. This patient also recovered. Küster reports three cases, all of which were treated conservatively. In the first the diagnosis was made by bloody urine persisting for 8 days after a bullet wound in the lumbar region which healed in 6 weeks; in the second the penetration of the bullet from the left hip to the right kidney region was followed by a urinary fistula which rapidly closed; in the third case an autopsy two and a half months after death from infection showed a healed wound in the convex border of the right kidney with the bullet in the liver. This case was said to have run it's course without any symptom pointing to an injured kidney. In Walker's case, the bullet entering the right lumbar region passed through the lower pole of the right kidney and perforated the mesentery, filling the peritoneal cavity with blood. The kidney was sutured and the wound drained posteriorly. The patient made a tedious convalescence.

In Keuper's case, the bullet, entering the left mammary line below the costal border, penetrated the left kidney and the splenic vessel, which was badly torn and surrounded by an extensive hæmatoma. The kidney was removed and the damage to the splenic vessels necessitated also the sacrifice of the spleen. Drainage of both kidney and splenic areas, healing taking place by primary union.

Keuper's case is of special interest from the fact that prompt recovery followed a simultaneous splenectomy and nephrectomy. The damage to two such vascular organs must have caused very considerable hemorrhage and have diminished, relatively, the resistance of the patient.

Through the courtesy of Drs. Dennis and Keyes, the writer adds brief extracts of cases of gunshot wound of the kidney which were treated by these surgeons in St. Vincent's Hospital.

(1) Man of twenty, shot in the back and right hip and elbow. There was hæmaturia for five days. Owing to a rather rapid fall in blood-pressure after the accident, no operation was performed. The patient made a good recovery. (2) A second case in which the kidney and stomach were penetrated by a bullet. Through a median laparotomy, the stomach was sutured. No nephrectomy was necessary. This patient also recovered.

The consideration of coexisting lesions of the kidney and gall-bladder of a non-traumatic origin deals with an entirely different pathological group, in that the changes that occur in either organ are probably entirely independent of each other and do not develop simultaneously. This leads to a confusing intermingling of subjective and objective symptoms, for while a distended gall-bladder is usually easily differentiated from an enlarged kidney, the coexistence of both conditions may modify the physical signs to such an extent as to make diagnosis extremely difficult. Furthermore, this difficulty may be still further increased, especially in women, by the presence of a "Riedel" modification of the right lobe of the liver.

The history that follows illustrates the possibility of error in diagnosis in coexisting lesions of these organs and emphasizes the importance of exploration in all doubtful abdominal cases even though the chances of benefit from such a procedure may be slight.

E. F., female; admitted to the service of Dr. Thatcher, May 10, 1912. Past history negative. Patient was always well until 6 months ago when she suffered from attacks of epigastric pain of a heavy, dull character, situated in the middle of the line and not affected either by respiration or by raising of the shoulders. This pain came on directly after eating, lasting from one to two hours and relieved by taking hot water. Occasionally the pain was intensified by movement from side to side. Neither during nor after cessation of the pain was any tenderness noticed. Shortly after the advent of the pain, patient suffered from attacks of coughing with the raising of small amounts of blood. There was no actual vomiting and the blood did not appear until some time after the coughing was first noticed. Four months ago, after the appearance of both the cough and the bloody expectoration, patient is said to have had an attack of pleuropneumonia and it was owing to the slow convalescence from this illness that she was recommended to the hospital for treatment. During this time as well as after her admission to the hospital patient suffered from a continuation of the epigastric pain and the persistent coughing, which together with a tendency to faint when getting out of bed, constituted her chief complaints. There has never been any symptom pointing to disturbance of the urinary tract. During the 6 months prior to her admission in the hospital patient has lost about 60 pounds.

Examination shows in the midline a rounded tumor, extending below to within one-half an inch of the umbilicus while its upper limit is not well-defined. Its surface is smooth, its consistency is firm and in its widest diameter is about four inches. It is slightly movable with respiration and from side to side. At the time of the first examination the right kidney was not "palpable," but later this organ could be made out. A clinical diagnosis of carcinoma, probably of the stomach, was made. This diagnosis seemed to be substantiated by the findings in the stomach. This organ contained a large amount of thick tenacious mucus and was cleaned with difficulty. There was no macroscopic blood. The analysis of the gastric contents showed a total acidity of .036 per cent., an absence of free hydrochloric acid, no lactic acid and a moderate reaction showing the presence of blood. A second analysis several days later yielded a similar result.

Routine examination of the urine showed a large amount of pus. This led to an investigation of the bladder by Dr. Osgood and it was found, that while the urine from the left kidney was normal, that from the right was very scanty and almost entirely purulent. An X-ray then taken disclosed the presence of a large calculus in the right kidney.

On subsequent examination the mass seemed to extend into the right hypochondrium and back toward the lumbar region, and it was thought that the line of demarcation between it and the kidney could be demonstrated.

The patient was anæmic, the general leucocytosis was 18,000, with a polymorphonuclear count of 79 per cent. A Wassermann reaction was negative.

During the next four weeks the patient ran an irregular temperature with evening exacerbations. While it was realized that under ordinary circumstances the calculus, together with the remnant of the right kidney should be removed, the propriety of this measure was questioned, in view of the fact that the patient, if suffering from extensive malignant disease, could scarcely hope for any permanent relief. Four weeks after admission to the medical ward, having been seen several times by the surgeon in consultation, she was transferred to the surgical side for operation which, in view of the doubtful diagnosis, seemed to be warranted. On examination at this time, it was realized that a part of the mass at least was due to the condition of the kidney but that a considerable portion situated more anteriorly could not be accounted for in this way.

Operation.—Ether. The kidney was exposed through the lumbar route and was found to be extensively adherent to the investing perirenal fat. It was markedly lobulated, measuring 17 by 19 by 7 cm., its capsule non-adherent, its denuded surface finely granular. It presented multiple abscesses with a moderately distended pelvis which contained a large branched calculus extending into the dilated calices. There were several other calculi nearer the periphery of the organ. Microscopical examination showed a chronic suppurative nephritis with a calculous pyonephrosis (made by Dr. A. V. Whipple). The kidney was removed, the pedicle being divided between clamps to avoid soiling of the operative field. The peritoneal cavity was then opened along the outer margin of the colon. This permitted a thorough exploration of the region of the pylorus, the duodenum and the gall-bladder. This last-mentioned organ was found to be greatly distended and enlarged, and was presumably the site of a chronic cholecystitis. The pylorus, the adjacent part of the stomach, and the duodenum were normal. The peritoneal cavity was now sutured and the lumbar incision closed in the usual way with drainage. The patient made a prompt recovery but has hitherto refused to submit to operation for the distended gall-bladder which was felt unchanged 6 months after operation. She left the hospital.

Post-operative Notes.—Five months after operation, patient was in very good condition. Both the pain and the cough had disappeared and she had regained some of her lost weight. The gall-bladder was still palpable, as at the time of her discharge from the hospital, but was not sensitive. Nineteen months after the operation patient had regained all her lost weight and was able to eat all kinds of food. She has never felt so well during the past five years as at present. On examination, the gall-bladder can no longer be felt. In its place there is a slight sense of resistance and the patient states that the only indication of the former trouble is the occurrence of slight occasional cramps in the gall-bladder region.

The most careful consideration of the history of this patient fails to disclose any symptom which could be ascribed to the condition of the gall-bladder. Therefore, it is impossible to say which lesion was primary. The changes in either organ indicated lesions of long standing. That the symptoms, of which the patient complained, were due to the renal calculus, is clearly demonstrated by their prompt and permanent disappearance when the kidney was removed. Even the pain, which in its location was much more significant of cholelithiasis than of a kidney stone, completely vanished. That in renal calculus, the pain is sometimes referred anteriorly, must be recognized by all. The writer some years ago called attention to this fact and cited instances of the occurrence of pain from renal stones anteriorly below the level of the navel and on the affected side. The present case is the first instance that he has observed of pain from the cause referred anteriorly to an area above the level of the navel, and, what is still more unusual, as pronounced on one side as on the other.

The fact that the patient lost over 50 pounds within six months is, at her time of life, suggestive of malignancy. In her case, it was probably the result of her prolonged illness and of the associated "hectic" temperature. The diagnosis of cancer of the pylorus seemed plausible in view of the location of the tumor and of the results of the gastric analyses.

Had this condition actually existed, the size of the tumor would have indicated that it had probably reached an inoperable stage, in which event the removal of the calculus would have been of little value. On the other hand, in the absence of malignant disease, the removal of the calculus was clearly indicated. The fortunate intervention, carried out only after an exhaustive observation of the patient, must be ascribed to the fact that the physical signs were so obscure and in a measure so contradictory that only an exploration could unravel the mystery.

The fact that, at present, 19 months after the operation, the gall-bladder is no longer palpable, raises the question of whether the lesions of these two organs were accidental or whether, as a matter of fact, the gradual enlargement of the gall-bladder might not have resulted from the irritation due to the elimination of toxins arising from the chronic pyonephrosis. At the time of operation the condition of the gall-bladder seemed to justify a secondary cholecystectomy or cholecystostomy and the patient was so advised. The advice was repeated when, at the end of five months, the gall-bladder remained unchanged. At present, however, the fact that the gall-bladder can no longer be felt, seems to have rendered a second operation unnecessary unless there should be some subsequent exacerbation.

In conclusion the writer wishes to urge, in all doubtful conditions of the abdomen, the propriety of surgical exploration if by such means there is a chance, no matter how slight, of benefit to the patient.

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SPLENIC ANÆMIA WITH SPLENECTOMY (BANTI'S DISEASE).

A CASE REPORT, WITH REMARKS.

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THE designation, Banti's disease, was made because beginning about 1883 a Florentine pathologist by that name made successive reports of a condition in which he found primary enlargement of the spleen with accompanying anæmia followed by cirrhosis and ascites. To this complete symptom complex the name was applied by Senator.[1] Although primary splenic enlargement with anæmia, but without known etiology, had been observed to occur, yet its causative action in the anæmia and hepatic cirrhosis was first conceived by Banti.

Previous to this several authors had suggested sub-division of the leukæmias, so that Banti's suggestion met with quite general approval. Since his work it has been definitely further agreed that there is a group of conditions between the leukæmias on the one hand and the cirrhoses of the liver on the other, possessing some of the peculiarities of both conditions, yet distinct from them and with a distinct etiology.

The literature of the subject which has sprung up since 1883 is voluminous, has been well reviewed from time to time and from it may be gleaned the fact that our views of the cause and course of the group of splenomegalies are not at all clear and must be subject to frequent revision as the problems of normal and pathologic physiology are solved. The tendency at present is to divide this group into three divisions, viz.: splenic anæmia as distinguished by Osler,[2] Banti's disease and splenomegaly of the Gaucher type, regarding which latter disease a most excellent discussion by Brill and Mandlebaum appeared as below noted.[11] Many authors consider, however, that splenic anæmia and Banti's disease are different phases of the same condition and that such a case originates with enlarged spleen and anæmia as the early symptoms and terminates with cirrhosis and ascites or some secondary hepatic condition. The so-called Gaucher type, of French origin, comprises a small number of cases with hereditary tendency in which primary endotheliomatous growths occur in the spleen and metastasize to the splenic and portal veins and the liver.

As Klemperer[3] suggests, the name splenic anæmia seems preferable to that of Banti's disease and less liable to confusion. Such a name has a definite significance, being a necessary step toward a clear understanding of the subject.

For clinical study and especially diagnosis, three stages must be kept in mind; first, characterized by malaise, weakness, possibly repeated nausea, indefinite soreness in the splenic region, slight anæmia, lasting periodically from ten to fifteen years, occurring in young adults; the second stage that of splenic enlargement with urine scanty and dark colored, pigmented skin, diarrhœa, hemorrhages, lasting a few months to two years; the third stage that of hepatic enlargement, ascites with the other signs accentuated and terminating by cachexia, intercurrent diseases or exhaustion.

Death in one of the writer's cases of splenic enlargement was due to uræmic coma, with scanty urine, developing after eighteen months of repeated, rapid reaccumulation of ascites. The urine was progressively scanty, high colored, with but a faint trace of albumin and no casts. Post mortem, the kidneys were in excellent condition and certainly not a primary cause of the uræmia. It seems probable, therefore, that some factor other than renal disease was the cause of the fatal coma.

The ascites recurred in from seven to twenty-eight days for thirteen months, requiring twenty-nine tappings of from ten to twelve litres each. Such a condition must result in a disturbance of the normal circulatory balance in which an increased volume of blood goes to the peritoneal surface and by a progressive reduction of the fluid contents of the body insufficient water is present to carry on the normal body metabolism and excretion. This is evidenced by the progressively scanty urine which in other respects may be normal. The resulting toxæmia may be due to unexcreted products of metabolism or to the same toxins which acted etiologically in the splenic enlargement, anæmia, etc.

Some authors, especially Kartulis,[4] have described the occurrence of unexplained fever a few years before the onset of the condition.

As to etiology the way is divided between malaria and lues and a search for some specific infection not yet described. It is pretty generally conceded that the spleen is the primary seat of the disease, but whether such known agents as malaria, lues, kala agar, torsion of the pedicle, present all the causes, or whether a distinct etiologically unknown group exists is clearly stated but by a few authors.

As to treatment, splenectomy as early as possible, in fact, at any stage in which the patient can stand the operation, has been amply shown to be of the greatest benefit. The following case report will be of interest and is placed on record as a study of the condition.

Clinical Report.—The patient was a Polish woman, married, thirty-three years of age; father dead at forty-five years from injury; mother dead at seventy-three years of some condition producing dropsy. She has three brothers and two sisters living and well. There have been no tumors, nor recurrent diseases in the family history. She has three children living and well, the youngest one year old; has lost one of imperforate anus and one of summer diarrhœa; has had no miscarriages.

She has always lived as a working woman in this country, doing housecleaning, washing, etc. She has never used alcohol nor tobacco.

As a child she had no illnesses. Menses first occurred at 18 years, skipped two months, regular and without pain since. She has not menstruated for the past year since the birth of her last child, which was normal. She has never had malaria, typhoid nor any other acute infection. At 15 years of age she had some acute fever in which she was delirious, lasting two weeks.

Present Illness.—Five years ago she first noticed enlargement of the abdomen and felt a tumor of the left side between the ribs and the ileum, which has gradually increased and on account of which she comes. There has been some shortness of breath, gradual increase of weakness, very slight pain over the tumor, but has continued at her work daily. There have been no stomach signs, no vomiting, no distress, no loss of appetite and no eructations. She has had no signs referable to the urinary organs, no pain, no colic and no increased frequency, no hæmaturia, urine free. She has had no cough, no fainting, no dizziness, no pain in chest, no signs referable to the cardiovascular system. She has had no œdema, no eruption, no skin lesions of any kind except pigmentation as stated below.

Examination showed a fairly well nourished, slightly jaundiced woman of medium build, weight 138 pounds. The jaundice is apparent in the sclera only. Her skin presented a peculiar swarthy or brownish tinge equally distributed over the body. Mucous membranes and cheeks good color. The chest was negative to examination, except the heart, which showed some left hypertrophy. Temperature 98°, pulse 74, respiration 18. Abdomen rounded, full, largest circumference below the navel, muscles greatly atrophied and relaxed, recti diastased. Skin much wrinkled, peculiarly dry, harsh and pigmented brown. Liver: upper border 6–7–10th spaces, lower border palpable, sharp, firm, slightly tender, two fingers below the ribs and across the epigastrium. In the gall-bladder region could be felt two or three firm nodules the size of a hickory nut on its edge. The surface of the liver was felt to be rough. The spleen extended from the eighth space to the crest of the ileum and to within two inches of the median line. It was firm, smooth, and not tender. On its anterior edge could be felt two notches, the lower deeper than the upper. The whole spleen was very mobile and could be pushed about on the left side of the abdomen. No bruit could be heard over it. Kidneys: neither palpable nor tender.

Blood count before operation, June 24, 1913, red blood cells 4,900,000, white blood cells 4000, hæmoglobin 80 per cent.

July 18, 1913, red blood cells 4,500,000, white blood cells 3500, hæmoglobin 80 per cent., percentage of red blood cells 90, color index .9.

Differential count, large mononuclears 16.3 per cent., small mononuclears 15.1 per cent., polymorphonuclears 63.5 per cent., transitionals 4.2 per cent., eosinophiles .4 per cent., mast .5 per cent.

The red cells showed no marked variations in size. There were no nucleated reds. Poikilocytosis moderate. Central pale area was slightly increased. A moderate anæmia of the chlorotic type, with a marked leucopænia. Wassermann reaction was negative, one test.

Diagnosis.—Primary splenic anæmia. July 22, 1913. Splenectomy.

On the 23rd the blood count showed red blood cells 4,000,000, white blood cells 7200, hæmoglobin 80 per cent., percentage of red blood cells 80, color index 1. The differential count showed large mononuclears 5 per cent., small mononuclears 33.3 per cent., polymorphonuclears 56.6 per cent., transitionals 1.6 per cent., eosinophiles 2.5 per cent., mast .9 per cent.

The blood picture varies from that before operation in there being after operation a larger number of white cells present and an increase of small mononuclear lymphocytes at the expense of the polymorphonuclear cells, a relative lymphocytosis. The red cells show some slight variation in size as before, but the central pale area is a little more marked, poikilocytosis is the same as before operation. There is an occasional nucleated red cell of the normoblastic type.

July 27, 1913, red blood cells 4,800,000, white blood cells 13,300, hæmoglobin 90 per cent.

Urine: The urine was persistently scanty both before and after operation. For the twenty-four hours preceding operation (the patient had had a cathartic two days before) it was 1000 c.c., dark amber, clear, specific gravity 1013, acid, albumin a trace, sugar none present, contained a few leucocytes, bladder epithelia, no casts, many oxalate crystals and amorphous urates. Total nitrogen 5.96 grammes, ammonia nitrogen 6.5 per cent. of the total nitrogen.

The twenty-four hours following operation 870 c.c. Specific gravity 1032, strongly acid, dark amber color, heavy precipitate of urates, albumin a trace—less than before operation, sugar none. Total nitrogen was 12.3 grammes, ammonia nitrogen 5 per cent. of the total nitrogen.

Sixth day after operation 1140 c.c. Total nitrogen 13.9 grammes; ammonia nitrogen 4.5 per cent.

Seventh day 2050 c.c. Patient has drunk very heavily of water and this is the only time either before or after operation that the urine was above the average in quantity and contained 14.87 grammes total nitrogen, 6.3 per cent. ammonia nitrogen. Following this the urine persistently stayed at less than 1000 c.c.

Ninth day 960 c.c., 10 grammes total nitrogen, 7.2 per cent. ammonia nitrogen.

Seventeenth day 930 c.c., 4.3 grammes nitrogen; ammonia nitrogen 7.8 per cent. total nitrogen.

Six weeks after operation urine was normal in every way; specific gravity 1010, acid, albumin and sugar negative and pale amber in color.

Umber [5] has reported a study of the nitrogen excretion in two cases of Banti's disease with splenectomy. In both cases he reports an increased nitrogen loss with a constant intake, body weight stationary. After splenectomy the nitrogen exchange became normal and there was a slight gain in weight. He believes the toxic factor is removed with the spleen.

In neither of Umber's cases was the characteristic blood picture of Banti's disease present, there being a slight leucocytosis instead of a leucopænia and the marked post-operative leucocytosis almost universally reported did not occur. The nitrogen output of the above case was normal, as well as the proportion of ammonia nitrogen, both before and after operation. This coincides with Stengel's opinion,[6] *i.e.,* "Disturbed metabolism is a feature common to other conditions allied to Banti's disease and probably in Banti's disease it is merely a phase in its course."

Surgical Report.—Patient operated on July 22, ether anæsthesia, iodine preparation. Vertical incision through the left semilunaris four inches long. There was a slight amount of fluid in the abdomen, peritoneum was markedly thickened, the pelvic organs were negative, both kidneys were palpable and of normal size. Stomach normal. The liver—left lobe showed a very marked, finely granular cirrhosis. The same condition was felt in the right lobe, and the nodules which had been palpated on the edge of the liver were found to be due to contracted bands of fibrous tissue. The gall-bladder empties on pressure.

The lower end of the spleen was first delivered and rolled out away from the operator, the vessels being caught as they came into view. The spleen was exceptionally long, tongue-like in shape and showed four points at which large vessels entered. The vessels were caught with rubber-guarded clamps to prevent tearing of the very delicate veins. Some difficulty was experienced in separating the spleen from the diaphragm to which it was adherent. Ligation with silk. Closure with plain gut, chromic gut on the aponeurosis and silkworm. Duration of operation forty minutes.

Pulse 94, respiration 16. The pulse promptly dropped to 76 after operation. On the following day the patient showed a rise in temperature to 101$^3/_5$°, pulse 72. This, however, subsided on the same night, and from thence on the temperature continued between 99° and 100°, finally remaining at 98 and a fraction after the ninth day.

Pathological Report.—A spleen, weight three pounds, 10¾ x 4¾ x 1¾ inches. The capsule is thickened, surface slightly roughened, of a bluish-gray color. On the concave surface are four points of entrance of large vessels two inches apart. Consistency unusually firm both to pressure and to the knife, cut surface beef-like in color, abnormally dry. Very little pulp can be scraped off with a knife. No malpighian bodies are visible. The veins are somewhat thickened.

Microscopically the characteristic feature of the spleen is the very marked endothelial proliferation. This has progressed to such an extent that there is very little pulp left. The endothelial cells of all the lymph sinuses, the capillaries and the blood-vessels are greatly swollen. The sinuses in places are apparently obliterated, and in such areas there is almost complete absence of the pulp cells; an occasional lymphocyte is found in the capillaries. In other areas the process is less marked and the lymphocytes are more numerous. There are occasional polymorphonuclear cells and eosinophilic cells present.

The endothelial cells of the capillaries and smaller vessels are frequently so greatly enlarged as practically to occlude the vessel lumen. The larger vessels also show this change together with thickening of the vessel wall.

The malpighian corpuscles are diminished very considerably in size, probably to one-half or one-third the normal. The central part of the corpuscle has not the usual looseness of structure but seems to be more compact, the lymphocytes lying more closely together and the supporting cells are unusually visible. The periphery of the corpuscle has the characteristic endothelial proliferation. The artery of the corpuscle also shows the thickened endothelium and wall.

As would be expected from the unusually firm consistency of the gross specimen, there is increase in the connective tissue of the organ. The capsule is roughly three times the normal thickness; the trabeculæ are increased in size; the interstitial tissue in the pulp has also proliferated considerably. Throughout the organ are small granules of brownish pigment. The capillaries and connective tissue in the trabeculæ contain considerable of this pigment.

In conclusion the characteristic feature of the spleen is the marked hypertrophy and hyperplasia of the endothelial structures, with very great diminution in the pulp substance and decrease in size of the malpighian corpuscles.

The liver section shows marked fibrous tissue proliferation confined to the interlobular structures, forming a multilobular cirrhosis. The intralobular connective tissue and the liver cells present nothing abnormal.

The peritoneum is considerably thickened and exhibits hyaline degeneration.

The points to which I wish to draw attention in this case report are the unexplained fever a number of years before, the absence of malaria, lues or an alcoholic habit, the development of primary splenic enlargement, the leucopænia before operation, the leucocytosis after operation of a lymphocytic type (*cf.* 1, 7, 8), and the marked improvement of the patient after splenectomy, the endothelial proliferation approaching that seen in the Gaucher type of splenomegaly.

Later observations, August 30, red blood cells, 5,200,000, white blood cells, 12,000, hæmoglobin, 95 per cent.

The anæmia has rapidly been corrected. The leucocytosis was due to the relative lymphocytosis as in the other counts after operation. It has required as long as five years for the re-establishment of the normal differential leucocyte count in cases reported by Banti, Senator, Wolff.

I am greatly indebted to Dr. E. P. Neary of Charity Hospital resident staff for most careful blood counts, to Dr. H. H. Haskins, Associate Professor of Organic Chemistry, W. R. U., for urine analyses, and to Dr. J. D. Pilcher of W. R. U. for his report on the pathology of the specimens. I shall be pleased to furnish a rather extensive bibliography to anyone desiring it.

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ILEOCÆCAL TUBERCULOSIS.*

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Our knowledge of this subject really dates from 1891, in which year Billroth in Vienna, and Hartmann and Pilliet in Paris, simultaneously insisted on the fact that tubercular lesions existed in the cæcum, lesions which had before then been taken for carcinoma. Since then we have found out that the cæcum is more frequently the seat of tuberculosis than any other part of the alimentary tract. Both sexes are equally affected; one observer reported 36 males and 42 females, and another 48 males and 35 females. It is found oftenest between the ages of twenty and forty years. Clinically there are two sets of symptoms, first, those of peritoneal reaction, and second, those of intestinal stricture. As the disease, when left to itself, is always fatal, operation is indicated in all cases.

Thirteen years ago the writer was fortunate enough to operate on a very complicated case, which finally turned out to be an ileocæcal tuberculosis. Ever since then he has been on the lookout for these cases, and has succeeded in recognizing about ten others at operation. No doubt some others were overlooked or were operated on as cases of appendicitis. Cases of simple tubercular ulcers in the appendix are not included in this paper. We believe that these cases of ileocæcal tuberculosis are not so rare as the scarcity of the literature would make us believe. They are often mistaken for cases of appendicitis with inflammatory exudates. We have several times operated on such cases but were unable to get a positive diagnosis of tuberculosis from the material removed, although we felt quite sure that we had to deal clinically with tuberculosis.

It was in the hope of throwing some light on this rather neglected field of abdominal surgery that we decided to report our cases. And we were the more prompted to do so by the fact that we were unable to find a single monograph by either an English or American surgeon on this topic. Most of our cases were operated upon in Dr. Lilienthal's service at Mt. Sinai Hospital since 1906. Before 1906 the cases were rarely recognized, and our records are not as accessible or as complete before that date.

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* Read before the Surgical Section of the New York Academy of Medicine.

In spite of the fact that the ileocæcal region is one of the sites of election for intestinal tuberculosis, but little has been written on the subject, and our text-books almost ignore it. This we believe is at least in part due to the difficulty in making the diagnosis at operation, or even by the pathologist. Many of these cases, perhaps most of them, come to operation with the diagnosis of appendicitis. We find an inflammatory tumor which the pathologist usually reports as "chronic inflammation." We remove the appendix, sometimes a fecal fistula develops, which we close at a subsequent operation. Every surgeon sees such cases and puts them down as cases of appendicitis. In some of them there is a tubercular ulcer inside of the appendix or cæcum, with an inflammatory exudate around the intestine. If we remove some or all of this exudate, the pathologist is quite right in calling it inflammatory. If we ask for serial sections through the appendix or cæcum (if it was removed) then often a small tubercular ulcer will be found, and the diagnosis cleared up. The first case that the writer encountered was a case of this kind. At the first operation the greater part of a large inflammatory tumor around the cæcum was removed, and on section was pronounced chronic inflammation. At a subsequent operation, more of the tumor and the greater part of the appendix were removed, and again pronounced chronic inflammation. At a third operation for the closure of a fecal fistula, the stump of the appendix was removed and again the report came back chronic inflammation. We requested that more sections be made and finally a typical tubercular ulcer was found in the appendix and the diagnosis was established. Since then the writer has frequently seen similar cases, but in very few could the diagnosis of tuberculosis be substantiated by the microscope. We must not forget that in most of these cases the cæcum is not removed and the tubercular focus is often inside of the cæcum.

The most practical classification of these cases was made by Hartmann. He distinguishes two classes of cases: First, ulcerative enteroperitoneal tuberculosis of the cæcum; second, hypertrophic cæcal tuberculosis, the so-called ileocæcal tubercular tumor.

In class one we find either ulceration with perforation and abscess formation, in which case the disease is serious and hard to cure, especially as fecal fistula often develops; or, we find ulceration with stenosis, and frequently adhesions to the adjoining viscera or to the parietal peritoneum.

Class two is the chronic form to which attention was drawn by Billroth, Czerny, Terrier, and Hartmann. These cases usually present a palpable tumor, often of considerable size. The neighboring lymph-glands are usually enlarged.

Etiology.—Is the disease primary or secondary? Conrath believes that in children we do find it as a primary lesion, but that in adults it very rarely is. Hartmann, Baum and others, on the contrary, believe that it often is a primary disease. Tomita, likewise, reports four cases in which the lungs and other organs were sound. This was true in at least three of our cases. In seven cases, Baum twice found a slight pulmonary tuberculosis, and in one case a tubercular peritonitis and an advanced pulmonary process. Campiche collected 279 cases and in less than one-third was there a pulmonary lesion; and ten per cent. had extensive intestinal and peritoneal tuberculosis. Now is it fair to assume that the ileocæcal lesion is secondary because there is a slight pulmonary tuberculosis? It is even possible, in some cases, that the pulmonary lesion may be secondary to the ileocæcal lesion. I myself saw such a case at the very beginning of my medical career. The patient, a lady of about forty years, had always been well until she developed an ileocæcal tuberculosis. The appendix was removed and the abscess drained, but the wound did not heal, and six months later she developed an acute pulmonary tuberculosis, from which she died. The tubercle bacilli get into the intestine either with food or drink, or are swallowed with the sputum.

A tubercular ulcer in the appendix will not always give symptoms. In one hundred consecutive autopsies of cases that died of tuberculosis, Sonnenburg found two cases of tuberculosis of the appendix which had given no symptoms.

Preëxisting ileocæcal disease is a predisposing factor to the development of ileocæcal tuberculosis, *e.g.*, the swallowing of tubercular sputum infecting a preëxisting ulcer of appendix or cæcum. But even in cases without pulmonary tuberculosis repeated inflammation of the appendix will leave damaged tissues which are prone to tubercular infection. That these preëxisting inflammations in the appendix and cæcum play a rôle is proven by Hartmann, who found that in eighty-five per cent. of all intestinal tuberculosis the ileocæcal region was affected. In nine per cent. of the cases only the ileocæcum was affected. Anatomic relations no doubt also play a rôle. In the small intestine the fecal current is pretty active and the bacilli are carried along rapidly by the stream. But when they enter the cæcum there is a marked slowing of the current, which suddenly is deflected to a right angle, and then travels uphill. This gives the bacilli an opportunity to become lodged, either on a preëxisting ulcer, or in one or other of the lymph follicles, which, especially in children, are very abundant in this region. Another source of infection is the mesenteric glands in the vicinity of the ileocæcum. From them a retrograde infection of a preëxisting cæcal ulcer can take place.

Pathology.—In the enteroperitoneal tuberculosis of the cæcum we first find tubercles in the mucous membrane surrounded by an inflammatory zone. These tubercles coalesce and form a flat ulcer with undermined edges. If such ulcers heal they produce more or less stenosis. As the process progresses tubercles develop on the serosa, and through these lymphatics become infected. As a result of the inflammation there is an adhesive peritonitis and the neighboring loops of small and large intestine become adherent to one another and to the parietal peritoneum, and thus a palpable tumor may result. In this way the disease may be limited to the affected area. In other cases there is a cheesy degeneration of the tubercles and an abscess develops. In some cases the ulcer of the mucous membrane spreads through the muscular and serous coats, causing a perforation of the intestine, and a resulting abscess. This is the pathological picture in the enteroperitoneal or ulcerative cases.

In the cases of tubercular ileocæcal tumor, the process is more localized and spreads upward along the cæcum, whereas in the ulcerative cases the ileum is more affected. There is no cheesy degeneration, not much ulceration, but an enormous production of connective tissue. The cæcum is the seat of a firm fibrous tumor, with which the appendix is usually intimately connected. The hypertrophy involves all three coats of the intestine. The serosa often shows no signs of tuberculosis, the mucous membrane is the seat of ulceration, although the tumor can develop without ulceration of the mucous membrane. There is regularly stenosis of the lumen. Adhesions to the parietal peritoneum come only late in the disease. This free mobility is an important sign in the differential diagnosis. The slight or absent cheesy degeneration, the difficulty in finding tubercle bacilli in the microscopic sections, would lead us to believe that few and not very virulent bacilli cause the disease. The chronicity of the disease, likewise, speaks for this. The enormous connective tissue formation is so uncharacteristic of tuberculosis that some authors have doubted it. But there are other tubercular lesions which resemble it. Langhans was the first to point out the similarity to hypertrophic forms of lupus. Here also we have a slowly progressing disease, with extensive cellular exudate, replaced in time by scar tissue; and in lupus also we find few tubercle bacilli.

Symptoms.—1. Enteroperitoneal form. The symptoms are not characteristic. There is gradual increasing pain in the right iliac fossa lasting several months; later, nausea, vomiting, and belching. At times we find a slight evening temperature, loss of weight, and sometimes diarrhœa with blood and mucus.

After a certain time a mass is felt; it is usually hard and not sharply defined.

2. Ileocæcal tubercular tumor. At first the symptoms are similar to those found in the enteroperitoneal form. The patient sometimes dates the onset of the disease to a trauma; there is either diarrhœa, or alternating obstipation and diarrhœa. This by some authors is considered a characteristic symptom. Later there is a stricture of the gut, and then we find severe colic. The writer recently operated on a case of this kind, in which the first symptoms were those of intestinal obstruction. There had been no preëxisting symptoms referable to the intestine. Usually the colic at first is mild and then gradually increases in severity. As many as ten attacks have been noted in one day. Later we find vomiting, chills, fever, meteorism, and intestinal peristalsis becomes visible; in other words the picture of intestinal obstruction. In the right iliac fossa a tumor of considerable size can be felt, it is not very tender to the touch and is regularly freely movable. By distending the colon through the introduction of air into the rectum, the tumor can be made to approach closer to the abdominal wall, and can then be more easily palpated. According to Conrath the average duration of the hypertrophic cases is two and a half to three years, although it is hard to state exactly when the disease started. But we do know that it is a chronic disease, in the absence of complications, and that the patients, if not operated upon, die after a long time, either of cachexia, pulmonary or intestinal and peritoneal tuberculosis.

Diagnosis.—1. Enteroperitoneal form. It is very difficult, if not impossible, in many cases to differentiate it from appendicitis. If the general condition is very poor, or if there are sweats or persistent diarrhœa, the diagnosis is easier.

2. The hypertrophic form. In the early stages it resembles very much the ulcerative form and the diagnosis is very difficult, not to mention again the similarity to appendicitis. But we must also differentiate it from malignant neoplasms. In carcinoma we do not find the symptoms of intestinal obstruc-

tion, certainly not so early in the disease. The pain is not so severe, and the tumor is more apt to be fixed. Salzer states that if in a given case we find a long-standing stenosis of the gut with a freely movable tumor, the diagnosis is tuberculosis and not carcinoma. In tuberculosis the tumor is more apt to be smooth, in carcinoma nodular. In children we must also differentiate from ileocæcal intussusception, especially the chronic form.

Treatment.—1. Artificial anus formation. 2. Complete intestinal exclusion. 3. Ileocolostomy, with or without intestinal exclusion. 4. Partial or complete excision of cæcum and ileum.

The removal of the appendix is indicated in practically every case.

1. *Artificial Anus Formation.*—This is rarely indicated, and then only as a temporary expedient in desperate cases, to be followed later by a lateral anastomosis or an excision. Statistics show that 83 per cent. of these artificial anus cases die.

2. *Complete Intestinal Exclusion.*—This operation was performed in a few of these cases, but it would very rarely be indicated to-day.

3. *Ileocolostomy, with or without Intestinal Exclusion.*—This simple operation, with a low mortality rate, will cure a large number of our cases. We have been accustomed to do it by the same technic that we employ in doing a Moynihan gastro-enterostomy, using clamps and linen sutures. The ileum and cæcum, at least three inches away from the diseased area, are approximated without tension. Clamps are applied as in doing a gastro-enterostomy, and a posterior continuous serous suture is applied. The intestine is then opened, the redundant mucous membrane excised, and the interior of the gut is carefully swabbed out with alcohol. A running continuous suture (Connell) quickly closes the intestinal canal. This suture passes through all the coats of the gut and the knot is on the inside. The clamps are now removed and if there is any leakage (which there should not be) one or two reinforcing sutures of linen are applied. The posterior continuous serous suture, which had been left long, is now continued anteriorly as a serous suture,

covering the through and through suture completely. If there was no abscess, after removing the appendix, the abdomen is closed without drainage. The anastomosis should be made far enough away from the diseased area to allow, if necessary, of a subsequent resection of gut. If desired, this lateral anastomosis can be combined with an intestinal exclusion. This would be indicated in cases involving a large part of the ileum and ascending colon. But in many of the cases the anastomosis alone will bring about a cure. Alglave collected 29 cases of lateral anastomosis (in some cases with intentional formation of a temporary fecal fistula) with 27 recoveries, a mortality of less than 7 per cent. The mortality after intestinal resection is more than twice as high. In desperate cases a simple incision and drainage, perhaps with the removal of the appendix, will be life-saving, and a lateral anastomosis can be done at a later sitting. If the disease is extensive, the operation advocated by Lane for severe cases of atony of the colon can be done. The ileum is divided, both ends closed, and a side-to-side ileocolostomy or ileosigmoidostomy done. In this way part of the ileum, the cæcum, and the colon can be excluded.

4. *Excision of Intestine.*—Extensive adhesions around the diseased area form a contra-indication, on account of the great risk involved, to an immediate excision. If the tumor cannot be lifted out of the abdomen, the dangers of an excision are too great. If the tumor is freely movable and an excision is to be done, after lifting the tumor out of the abdomen, the mesentery of the ileum and the mesocolon are ligated close to their intestinal attachments and divided. The ileum and cæcum are clamped and the diseased intestine is then cut away. The ends of the intestine can be united in various ways, but the best results have been obtained with side-to-side anastomosis with sutures, after first closing both open ends with several layers of sutures. Mikulicz did the resection in two stages. At the first operation the tumor was brought out of the abdomen and the abdominal wound was carefully sutured. At the second operation the intestine was resected. Far better it seems to us to do a lateral anastomosis at the first operation; and then, if necessary, at a second sitting to do the resection. If we proceed

along these lines we will cure many of these cases by the first operation, and with a very low mortality rate. Whereas the intestinal resection, whether done at one or two sittings, will always give a high mortality. If the resection is done at the first operation, not only will the mortality be very high but we will sometimes be doing a resection where a lateral anastomosis alone might bring about a cure. Hartmann, in 1907, advised intestinal resection in the hypertrophic form, together with the removal of the glands in the ileocæcal angle. Where there is an extensive mass of adhesions and the resection in consequence is too dangerous, he advises intestinal exclusion. Alglave collected 50 cases of resection of ileum and cæcum with 7 deaths, a mortality of about 14 per cent. We believe that if all cases were reported, the mortality from primary resections would be considerably higher.

Breiger, in his excellent Inaugural Dissertation, collected 27 cases operated by resection, from 1905 to 1909. The operation showed a mortality of 15 per cent. Campiche, who collected the cases prior to 1905, found an operative mortality following resection of over 20 per cent., *i.e.,* of 154 cases of resection 34.41 per cent. were cured permanently, 20.12 per cent. died shortly after the operation, and 13.63 per cent. died of the disease at a later period. In this same list of Campiche we find 35 cases of lateral anastomosis with partial intestinal exclusion, with an operative mortality of 11.43 per cent., a later mortality of 25.7 per cent. and 45.7 per cent. permanently cured. In other words, not only does the lateral anastomosis give a very much lower mortality than resection (about half) but the percentage of permanent cures after the lateral anastomosis is also greater. Of course we must not lose sight of the fact that the lateral anastomosis was probably done oftener in the earlier cases, and the resections in the more extensive cases. But even taking this into account, for the reasons given above, we firmly believe that the lateral anastomosis, with or without intestinal exclusion, should be our operation of choice in the large majority of our cases. And we must not forget that these patients come to us in none too good condition. We usually find marked anæmia, loss of weight, often subacute intestinal obstruction, and at times peritonitis and abscess formation. Such patients do not stand primary intestinal resection well. But even in desperate cases a lateral anastomosis will overcome intestinal obstruction, thereby tiding over a critical period. And even desperate cases will often improve so much that no further operation will be necessary. In some cases the intestinal obstruction *per se* is the cause of the patient's poor general condition. The tubercular ulcer may even be healed, leaving a stricture with a large inflammatory exudate around it. These are ideal cases for lateral anastomosis.

Conclusions.—Ileocæcal tuberculosis is usually a primary lesion. The infection takes place either from tubercle bacilli that have been swallowed (milk or sputum) or through the mesenteric glands. Pathologically we distinguish two forms, the ulcerative or enteroperitoneal and the hypertrophic ileocæcal tumor. The diagnosis is very difficult owing to the similarity to appendicitis, with which diagnosis most cases come to operation. The two operations to be considered are lateral anastomosis with or without exclusion, and resection. In the majority of cases we suggest the lateral anastomosis first, and there will then often be no secondary operation required; or, if required, it will be done under much more favorable conditions.

CASE I.—Barnett S., twenty-five years, cap maker, admitted February 25, 1906. Family history negative. Previous history, four months ago attack of right iliac colic with vomiting, lasting three days. Right lower abdomen tender for following five weeks. Present trouble began eight days ago with right iliac colic; vomited twice. Colic lasted two days. Bowels constipated. At present patient has burning pain in right iliac region.

Physical examination, G. C. good, well nourished. Abdomen flat, symmetrical, no rigidity. In right iliac region is felt a small nodular mass, somewhat tender.

Operation (February 28).—Dr. Wiener. Resection of ileocæcal junction, end-to-end anastomosis. Findings, moderately hard inflammatory mass involving wall of cæcum and ileum at ileocæcal junction, and involving mesentery of ileum. Several enlarged soft glands in mesentery.

Patient reacted nicely, ran smooth course until ninth day, on which day he died suddenly with symptoms of cerebral embolism.

This operation was done eight years ago. To-day in a similar case I would do an ileocolostomy. The exact cause of death is unknown. But even if the patient did have a smooth convalescence for nine days and then died suddenly with symptoms of cerebral embolism, the writer believes that the patient would have recovered if no intestinal resection had been done.

Case II.—Louis S., age forty-five, peddler, admitted May 9, 1907. Family history negative. Past history, pneumonia two months ago. Present trouble began eight days ago with sudden sharp pain in right iliac fossa. Pain was localized here for two days and then became general over entire abdomen, stabbing in character. Bowels regular, no blood in stool, no dysuria. No sweats, no chills. Appetite good. No vomiting, moderate fever. Temperature 99.6°, pulse 100, respiration 26. Tubercle bacilli found in sputum.

Physical examination, G. C. fair, some anæmia. Lungs: Signs of cavitation at right apex. Abdomen: Irregular tender mass, size of a hen's egg, in right iliac fossa.

Operation (May 9).—Dr. Wiener. Abdomen opened. Ileocæcal region thickened and imbedded in adhesions and exudate. When adhesions were separated considerable pus escaped. Specimen of inflammatory tissue excised for examination was reported as tuberculosis. B. M. drain inserted, abdomen closed.

July 1, small granulating sinus persists. G. C. improved. Patient discharged. No subjective symptoms. Weight stationary at 90 pounds.

We firmly believe that many cases of this kind are put down as cases of appendicitis. Had we not suspected tuberculosis and sent some of the inflammatory tissue to the laboratory, this case also would have been overlooked. This case should have had an ileocolostomy done.

Case III.—Nathan Z., twenty-eight, cigar-maker. Admitted June 6, 1907. Family history, father died of diabetes. Past history, for six months cough and bloody expectoration. Present trouble, onset twelve weeks ago with diarrhœa. Six to eight movements daily, stools watery and contain mucus. Loss of twelve pounds. Epigastric distress and abdominal cramps for past few weeks.

Physical examination, G. C. fair, emaciated. Abdomen: Retracted, scaphoid. Tender, rounded mass in right iliac fossa. Tenderness over entire colon. Lungs: Dulness and harsh breathing at right apex anteriorly and posteriorly. Glands: Moderate enlargement of cervicals, axillaries, and inguinals.

June 9, no diarrhœa since admission. Temperature 99° to 101°, pulse 92 to 108, respiration 24 to 30. Urine negative. Stool and sputum negative for tubercle bacilli.

June 21. Severe diarrhœa for several days. Operation by Dr. Wiener. Abdomen opened. Thickening and induration of ileocæcal region, with deposit of fine miliary tubercles on lower end of ileum. Appendicostomy done.

Post-operative treatment, irrigations with weak silver nitrate solution. Forced diet and tonics.

July 26. Patient's condition very slightly improved. Leaves hospital to-day at his own request.

Remarks.—Appendicostomy should no longer be considered in these cases. This case should have had an ileocolostomy done. He was told to return for further operation but did not report again.

Case IV.—Becky T., single, seventeen years, tailoress, admitted July 31, 1908. Family history negative. Menstrual history negative. Past history, typhoid at six years. Attack of general abdominal cramps with vomiting and fever three years ago, lasting one day. Since then occasional transient attacks of epigastric pain unrelated to the taking of food and unassociated with pain or vomiting.

Present trouble, for three months patient has had more or less continuous dull pain in right lower abdomen, with occasional attacks of severe cramps in same locality. Has been unable to work for past month. Seven pounds loss of weight. No sweats, no chills, no fever, no vomiting. No dysuria. Bowels constipated. One movement every three to six days. Temperature 99°, pulse 90, respiration 24.

Physical examination, G. C. good, well nourished, some anæmia. In right iliac region is felt a hard, elongated, irregular nodular mass, size of hen's egg. Mass is firmly fixed, somewhat tender. No rigidity. No other masses, no head zone. Lungs negative.

Operation (August 1, 1908).—Dr. Wiener. Abdomen opened. Inflammatory mass found consisting of ileocæcal junction thickened, and imbedded in adherent omentum. Appendix dissected from mass and amputated. Ileocolostomy done with sutures. Numerous enlarged hard mesenteric nodes palpated. No drainage. Duration of operation 1 hour.

August 8. Primary union. Temperature, pulse and respiration normal.

August 21. Symptoms alleviated, bowels regular, G. C. good. Sent to Betty Loeb Home to convalesce.

The patient returned in January, 1914. She had been well for five years following operation. She then began to have pain in the right iliac fossa when walking fast and when turning over in bed. During the past six months she had had three attacks of general abdominal pain, worse on the right side. With two of the attacks there had been vomiting. The general condition was fair and there had been no loss of weight. The examination of the lungs was negative. The abdomen was soft and not distended. In the right iliac fossa there was a small, soft, freely movable, tender mass. On opening the abdomen adhesions were found about the ileocolostomy opening which kinked it, and no doubt caused the attacks of subacute intestinal obstruction. There was no sign of any tuberculosis, and no enlarged glands were found. We made a new side-to-side ileocolostomy between the ileum proximal to the old anastomosis and the transverse colon. Recovery was uneventful.

Case V.—Ben. L., twenty years, butler, admitted September 20, 1908. Family history negative, previous medical history negative.

Present illness began eight days ago with sharp pains in right iliac fossa which have been persistent. Vomited once at onset. Some fever but no chills. Appetite fair, no loss of weight, bowels regular, no blood in stool, no dysuria.

Physical examination: In the right iliac fossa, rather high up and near outer border of rectus, is a mass size of an orange, slightly movable, not tender. No other masses. Examination otherwise negative. Temperature 99°, pulse 80, respiration 22. Urine negative.

Operation (September 25, 1908).—Dr. Wiener. Abdomen opened, ileocæcal region found to be very much thickened and surrounded by adherent omentum and plastic exudate. Ileocolostomy made in usual style. One cigarette and one tube drain placed.

October 25. G. C. good, temperature normal, moderate fæcal discharge from wound.

Operation (November 11).—Sinus excised, led to tiny leak in anastomosis. This leak was repaired with Lembert sutures, three rows. The appendix was removed and abdomen closed, small tube drain. The exudate present at time of first laparotomy was found to be entirely resolved.

December 12. G. C. excellent, wound healed. Temperature normal, patient gaining weight, no subjective symptoms. Discharged well.

This case demonstrates very well how even a large exudate will disappear after ileocolostomy is done. Seven weeks elapsed between the two operations and in that time the exudate had entirely disappeared. No microscopic examination was made in this case, but it was clinically an ileocæcal tuberculosis.

CASE VI.—Harry J., sixteen years old, office boy, admitted January 26, 1912. Past history, mastoid operation at six years of age. Best weight 96 pounds. Present trouble, three weeks ago sudden onset of abdominal cramps beginning in right iliac region. Had some fever, no chill, no vomiting. Bowels constipated, frequent and painful micturition for past few days. No blood seen in stool.

Physical examination, general physical, heart and lungs, etc., negative. Locally, abdomen: There is general rigidity of the abdomen. In the right iliac fossa may be felt a large, hard, rounded, discrete mass occupying the greater part of the lower right abdomen. Only slightly tender. Rectal: The pelvic floor is depressed by the abdominal mass which feels hard, just as by abdominal examination. Temperature 101°, pulse 104, respiration 24.

Operation (January 26).—Dr. Joseph Wiener. McBurney incision. Extraperitoneal mass encountered, on section soft yellowish-gray cellular tissue. Peritoneum opened and right pelvis found to be the seat of a large hard mass apparently connected with gut. A second mass was encountered and delivered, proving to be greatly thickened omentum. This was resected. The large mass was then bluntly opened with the finger, the appendix isolated and amputated. Abdomen closed without drainage.

January 28. Fæcal fistula established through wound.

February 10. Fæcal fistula has closed spontaneously.

March 2. Wound healed, patient discharged well.

Pathological Report.—Chronic inflammatory tissue, suggestive of tuberculosis.

Case VII.—Solomon M., baker, aged twenty-nine, admitted August 15, 1913. Family history negative. Past history negative. Present trouble, for past three weeks patient has had pains referred to right iliac fossa. No vomiting, moderate fever. Night sweats during past week. Has lost 20 pounds during past few weeks. White blood cells 10,500, polynuclears 68, lymphocytes 32. Temperature 98°, pulse 72, respiration 24. Urine negative. G. C. good. Lungs negative. Abdomen: In right iliac fossa is to be felt a hard, irregular, non-tender tumor mass size of an orange. Tumor is slightly movable upward and downward, but is apparently fixed to lateral pelvic wall.

August 18. Abdomen opened over mass. Ileocæcal region found to be thickened and surrounded by exudate, adherent to lateral pelvic peritoneum. Ileocolostomy, from ileocæcal valve to six inches from caput coli. Abdomen closed without drainage (Dr. Wiener).

August 31. Wound completely healed.

September 16. Patient on roof. G. C. much improved, no subjective symptoms, gain of ten pounds in weight since operation. One or two normal stools each day without cathartics. Temperature, pulse and respiration normal.

The night sweats and rapid emaciation led us to make a probable diagnosis of ileocæcal tuberculosis.

Case VIII.—Mrs. J. S., thirty-five years old, was first seen by the writer in July, 1913. Her parents were alive and well. There was no family history of tuberculosis. For the past year she had complained of a feeling of weight and a dull ache in the right iliac fossa. This ache had been present only at intervals, had not been severe nor had it increased in severity. She had had four children, who were alive and well. Six weeks before the writer saw her she had had a curettage done. This had been followed by vomiting, general abdominal pain, and distention. The bowels had moved with enemata. These abdominal symptoms lasted four or five days. Following this there were repeated similar attacks, the pain being most marked in the right iliac fossa. The attacks occurred once or twice daily and increased in severity. When on fluid diet, the attacks were less marked. These attacks were undoubtedly due to subacute intestinal obstruction and were more marked when the patient took solid food. On July 15, the abdomen was opened and an inflammatory mass found around the cæcum. The appendix and right ovary were removed. Following this operation the attacks of abdominal pain persisted. On July 29 the abdomen was again opened and a large inflammatory mass found involving two coils of ileum and the cæcum. One of the coils of ileum was distended and the other collapsed. A lateral anastomosis was made with sutures between these two coils of ileum, and the abdomen closed without drainage. Recovery was uneventful, and there was no return of the intestinal obstruction. When seen recently the patient had gained fifteen pounds, and the only thing that could be felt was a small indefinite mass in the right iliac fossa. When last seen in January, 1914, the patient had gained still more in weight and nothing abnormal was felt in the abdomen.

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THE EXPERIMENTAL STUDY OF INTESTINAL OBSTRUCTION.

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THE purpose of this paper is to correlate and summarize the work done in the Hunterian Laboratory of the Johns Hopkins University on certain aspects of the problem of intestinal obstruction, and to place the data thus obtained before a clinical audience. Frequent reference will be made to papers appearing in other publications of a somewhat different character from this, in which papers there are full reports of experiments performed and references to the literature of the subject. For this reason the present article will be devoted to a consideration of the general facts discovered and the inferences deduced therefrom, with but an outline presentation of the detailed evidence upon which these facts and inferences are based. Those desiring a closer study of the minutiæ will experience no difficulty in obtaining the articles referred to.

In the *Johns Hopkins Hospital Bulletin* for June, 1912, the authors of this paper published an article entitled "Intestinal Obstructions; A Study of the Toxic Factors." This paper dealt with a series of experiments conducted upon closed loops high in the intestinal tracts of dogs. It was discovered that when one ligates the duodenum just aboral to the pancreatic duct and again at about the point of mergence of the duodenum into the jejunum, death rapidly ensues, usually in 24 to 60 hours, although the continuity of the alimentary canal be restored by gastrojejunostomy or other operations for short-circuiting the occluded loop. Based on this fundamental finding a series of experiments was conducted to ascertain, if possible, why dogs with these high closed loops died. Thus the loops were washed before closing them and left empty. The ligatures were so placed that the secretions from the stomach, liver and pancreas could not gain access to the closed loop. In this manner it was believed that substances arising from food products, bile, gastric or pancreatic juice could be excluded as probable sources of the fatal results. The entire removal of the loop in question did not in any way interfere with the health of the animals. The ligations of the loop were executed in such a manner as to avoid any considerable disturbance of the circulation. From these experiments it was concluded that death was not due to the impairment of a part of the bowel necessary (*per se*) to life, nor was it due to any factor dependent upon the circulation of the bowel.

The symptoms of the dogs in the post-operative period were quite characteristic. The dogs soon showed that they were sick. They refused food, often vomited, and had every appearance of being intoxicated. A noticeable dulness and apathy began to develop. Slight muscular tremors commenced. The gait, especially of the hind legs, became staggering and ataxic. Weakness and muscular tremors rapidly increased and the pulse became very weak and thready. Near the end there was a marked fall in blood-pressure, a subnormal temperature, and great prostration. There seemed to be no pain.

The autopsy findings present a very uniform picture. Thorax, heart, and lungs are negative. Spleen, pancreas, kidneys, adrenals and blood-vessels are normal except for congestion. There may be a slight amount of dry plastic peritonitis over the closed loop and its adjacent loops. The liver may show some congestion and in some cases a little fatty degeneration. The closed loop is practically the only structure that deviates from the normal. It contains a greater or less amount of fluid, its walls are often mottled with purple areas of hemorrhage, and stippled with grains of fibrin. There may be areas of necrosis in the wall and in some cases these have led to perforation. The fluid in the loop is very characteristic, of a dirty slate or dull red color, about the consistency of thick soup, and often containing considerable mucus, blood, and desquamated epithelium. The material may be dry, pasty and like butter, but of slaty color. The mucosa of the loop may be normal or show a little diffuse reddening, or may be specked with ecchymoses and show shallow ulcers with red swollen margins. Microscopic examination of the organs shows only occasionally fatty degeneration of the liver. The duodenal loop may show acute inflammatory reaction, especially about the ulcers when these are present. In many cases, however, the mucosa is quite normal.

From a consideration of the manner of death just described, we assumed that the dogs were the victims of an intoxication, and that the toxic material originated within the loop. To test this assumption the fluid accumulated within the loops was carefully studied. The detailed experiments may be found in two papers published by the present writers in the *Journal of Experimental Medicine,* vol. xvii, No. 3, 1913. The fluid was usually digested for days at 38 degrees C, heated for one-half to one hour at 60 to 70 degrees, centrifugalized, and filtered through a Gooch crucible or porcelain perforated funnel. It was then administered to normal animals usually intravenously, and the effect observed with kymographic readings. There is usually a rapid profound fall in blood-pressure, followed by a rise to normal, and then a prolonged secondary fall to one-half or one-third of normal, if a lethal dose of poison has been given. The temperature falls, the pulse is scarcely palpable and there are conspicuous muscular tremors. Vomiting and profuse diarrhœa occur in cases where fatal doses have been given and the watery stools are blood streaked. Respiration becomes very slow and deep some time before death. Small amounts of the concentrated duodenal fluid may be sufficient to cause death within three to five hours, but the fluid varies in toxicity. At autopsy dogs killed within three to ten hours by injection of the fluid present characteristic findings. The blood remains fluid much longer than normal and clotting is slow. The liver, spleen, and mesenteric vessels show great engorgement. The gastro-intestinal tract shows the most striking changes. There is a moderate congestion of the mucosa of the cardiac portion of the stomach, but that of the pyloric end remains pale. About one centimetre below the pylorus there is a sharp line of demarcation separating the pale mucosa from the deep purple velvety mucosa of the duodenum. The duodenum is relaxed, usually contains fluid and its engorged mucosa is coated with thick mucus. The jejunum presents a similar picture, but the intensity of the color usually fades to pink in the lower ileum. The large intestine shows some congestion of its mucosa and ecchymoses are not infrequent. On microscopic examination, there is found great engorgement of the capillaries in the villi and no other change except occasionally some escape of red cells into the tissues. These findings are also encountered when the duodenal fluid is introduced into the peritoneal space of normal dogs, or subcutaneously instead of intravenously, except that death ensues some hours later, due no doubt to slower absorption.

It is quite evident from the facts just presented that the supposition of a poisonous substance or substances existing within these closed loops is correct. There are but two readily conceivable sources from which such a toxin might arise, the secretion of the mucosa of the duodenal loop or the activities of the bacteria present. It is of course possible that these two factors are both necessary and that their mutual interaction is the essential thing. In order to determine if possible which of these factors, if either, could be eliminated, repeated attempts were made to render the loops sterile without injury to the mucosa. All of these experiments failed to produce the condition desired. The other side of the problem was then attacked, and successfully. That is to say, by washing the loops with a four per cent. solution of sodium fluoride the mucosa was practically entirely destroyed, whereas bacterial growth continued unchecked. The fluid collected in such a loop did not possess the toxic properties on injection into normal dogs that were detailed above. In short the removal of the mucosa renders the formation of the toxin impossible and shows conclusively that it is essential to the development of the phenomena characteristic of these closed loop experiments. Further evidence will be adduced below to show that the intoxication following such closed loop experiments is due to changes in the mucosa itself and while not clearly understood as yet, are perhaps best described as due to a perverted physiological activity of the mucous membrane. That bacteria may play a rôle in instituting this perversion cannot at present be denied.

We have shown that when closed loops of the type under consideration are made, death results, and that in the loops there accumulates a toxin. Further, the source of this toxin is the mucous membrane of the loop. Does the toxin cause the death of the animal, or is it simply a collateral and not a causal phenomenon in the chain of development leading to the fatal termination of these experiments? At once the suggestion presents itself that an enterostomy into the closed loop, affording external drainage for its contents, might throw light on this point. Numerous experiments of this type were made, the loop being closed as usual, but then pulled up into the wound and opened so as to drain freely. Very interesting results were obtained. It is quite possible by such means to keep the animal alive for weeks or months—indeed, so far as we know, indefinitely—in favorable cases. And in all cases life is somewhat prolonged beyond the maximum period attained with the undrained loops. This would seem to show the intimate relation between the absorption of the loop poison and the death of the animal. The same relation is indicated by the similarity of symptoms in dogs dying from closed loops and those dying from the injection of loop toxin. We feel that it is safe to assume that the toxin described is really the active factor causing the death of animals with the duodenal loop. Parenthetically, it may be said here that other parts of the intestine have been studied to some extent by ourselves and in more detail by others, notably Bunting and Jones, *Journal of Experimental Medicine,* July, 1913. It is the general finding that the disturbances are most pronounced following the formation of loops in the duodenum and high jejunum and become markedly less as one approaches the colon.

Having concluded that the mucosa is primarily the source of the substance responsible for the intoxication, attention was directed toward a study of the mucosa itself. Repeated experiments showed that if the mucosa of a closed loop be carefully washed, then scraped off, and allowed to autolyze in normal salt solution in a thermostat for twenty-four hours, then treated as the loop contents were treated (described above) and injected intravenously into healthy dogs, it gave evidence of the loop toxin. In other words the toxin is not only in the lumen of the bowel in these cases, but in the cells of the mucous membrane itself. Furthermore, in the majority of dogs in which loops were drained, death occurred within five to eleven days, and the mucosa from these loops treated as just described also showed the presence of the toxin. (Why some dogs with drained loops die and why others survive will be considered later.) On the other hand ample experimental evidence has shown that the mucosa of the duodenum and jejunum of normal dogs, when treated in the same manner—washed, autolyzed, and injected as above—does not affect the animal in the least. Further information has been obtained in the same matter by Davis, working on certain phases of this general problem in this laboratory. In the *Johns Hopkins Hospital Bulletin,* February, 1914, he reports a study of the secretion of the normal mucosa of the duodenum and jejunum in dogs. This secretion was collected in dogs with no obstruction, but the bile and pancreatic secretions were excluded from the bowel. Duodenal secretions collected in this way, and as nearly normal as the conditions of the experiment would permit, were found to contain the toxin, with characteristic properties.

To summarize this rather confusing array of facts: the normal mucous membrane does not itself contain a demonstrable amount of toxin, but apparently under certain conditions does secrete it, whereas the mucous membrane under conditions of obstruction not only excretes the substance into the lumen of the bowel but also retains it within its own cells. Admittedly, we are unable to define more accurately the term "obstruction conditions." It does not mean simply retention of material in the lumen. Further, Davis, in the paper referred to, has proved that absorption, as tested by easily recognizable substances, is no better from within a closed loop than from the unobstructed lumen of normal gut—if anything, indeed, not quite so rapid. Hence we feel that the toxin within the cells of the mucosa and not that poured out into the lumen of the gut is the chief source of the systemic absorption and intoxication. There are many theories that may be advanced to account for the presence of the toxin in these cells—disturbed neurotrophic control, absence of normal mobility of the bowel wall, altered interaction of the various ferments and enzymes, etc.—that furnish a field for further research. For the present we must be content to say that under "obstruction conditions" there occurs a perversion of the physiology of the mucosa that leads to a retention or elaboration of toxin within its cells, and from this source comes the systemic absorption and intoxication.

The position taken by us, namely, that death in these cases is due to a toxin elaborated within the mucosa and absorbed from it, has not met with universal acceptance by those working in the same field of investigation. Hartwell and Hoguet (*American Journal Medical Sciences,* 1912, cxliii), in a series of experiments with simple obstruction in dogs, instead of isolated loops, showed that the animals undergo a great loss of fluid from vomiting and that life can be prolonged until starvation terminates it by supplying this deficit in water. From this and other facts they conclude that dehydration is the principal factor in producing death in simple obstruction. We do not claim that the isolated loops are identical with the simple obstructions encountered clinically. This form of attack on the problem of obstruction was chosen because it permitted the elimination of many of the possible factors that enter into simple obstruction, all of which cannot be properly valued when complicating each other. Having found the existence of the toxin above referred to in the loop experiments, it becomes relatively an easy matter to discover whether it exists in simple obstruction cases as well. Material obtained from several cases of human obstruction, as well as from simple obstruction experiments in the dog, has led us to believe that the toxin does exist in these cases as well as in the loops. The exact relation between the two conditions, as well as the direct bearing of our experiments on the clinical problems of intestinal obstructions, will form the subject matter of a paper now in process of preparation by the present writers. Hartwell, in a recent article (*Journal of Experimental Medicine*, August, 1913), has undertaken a critical review of the work published by us on the closed loops. He admits the existence of the toxin and its causal relation to the death of the animal, but quotes from our protocols of experiments to show that the degree of intoxication is proportionate to the amount of injury and necrosis shown by the mucosa of the isolated loop at autopsy. From this he concluded that the toxin with which we have been working is not dependent upon obstruction conditions at all, but upon insult to the mucosa, and that in a simple obstruction without any lesion to the membrane of the gut no poison would be evolved; hence the toxin formation is merely incidental to the obstruction and not the primary cause of death, which he still maintains to be desiccation with concomitant tissue changes. Our best answer to this chain of reasoning is to refer to numerous experiments quoted in detail in the articles already referred to, in which closed loops resulted fatally and showed a rich toxin content both of the mucosa and the loop fluid, but in which no gross or microscopic lesion of the mucous membrane other than a moderate hyperæmia was discoverable. So often is this the case that we do not feel that demonstrable damage to the mucosa plays any essential part in its propensity to form the toxin.

We have throughout the work on this subject used the general term toxin to designate the substance or substances obtained from the isolated loops in the manner described, and recognizable by the characteristic physiological properties. This vagueness of terminology is necessary because we have as yet been unable to obtain any accurate idea of the chemical nature of the substance or to secure it in anything like a condition of chemical purity. Certain of its properties we know. It can be heated without destruction for long periods at 60 to 70 degrees C. but boiling fresh fluid precipitates it by adsorption with other substances present in the fluid. Autolyzed fluid may be boiled without destroying the toxin. Prolonged bacterial and pancreatic digestion does not affect it.

Irrespective of the exact chemical nature of the substance causing the death of animals with high loops, the uniformity of its physiological effects suggested the possibility of developing a resistance or immunity against it. This suggestion has led to the working out of one of the most interesting aspects of the general problem, the detail of which, with full protocols of experiments, will be published shortly by the present writers. (*Jour. of Experimental Medicine,* February, 1914). In this place we shall merely outline the results obtained. It was found possible by repeated injection of sublethal doses of toxin in increasing amounts into healthy dogs to produce a marked resistance in such animals so that they could successfully withstand much more than a known fatal dose of the injected material. A study of dogs so immunized revealed the fact that the serum possessed no protective powers, but that parenchymatous organs, notably the liver, were apparently the site of the defensive adaptations. Thus aqueous extracts of liver from immunized dogs, when mixed *in vitro* with the toxic fluid, rendered the latter inert after autolysis for several hours. A similar power is exhibited by extracts of spleen, lung, and intestinal mucosa from immunized dogs when autolyzed with the toxin. From this fact has come the impression that some type of cell common to these various organs, perhaps endothelium, is concerned in the protective phenomenon. Extracts of liver from normal dogs may possess this property in slight degree. The idea at once suggested itself that the extract of immunized liver be tried on dogs suffering from the intoxication of closed loops, to ascertain whether the *in vitro* reaction could be in any degree paralleled by an *in vivo* test. Dogs were obstructed and allowed to proceed to marked intoxication when experience led us to believe that life would be terminated within a few hours. The results of these experiments will be published in detail. At this time we shall content ourselves with saying that it may be possible to prolong life by such a method. The discovery of an increasing resistance against the toxin has suggested an explanation of the results of our drained loop experiments. It will be recalled that these dogs exceed the life-period of the closed loop dogs and some have lived for long periods, others dying in five to eleven days. It is clear that the escape of loop contents by drainage eliminates a quantity of the toxin and we believe that what absorption occurs here takes place largely from the mucosa direct, without added reabsorption from material already excreted into the lumen. Hence the animal undergoes a slower and less overwhelming intoxication and has opportunity to develop some degree of immunity. The success of this defensive adaptation naturally varies with the individual animal, and thus occasionally a dog lived indefinitely, having attained a status in which it is able to neutralize the noxious product of the loop mucosa as rapidly as it is formed, whereas in other instances death is delayed a varying length of time by a defence which is inadequate, but nevertheless quite definitely observable. An interesting side-light on this question of immunity is afforded by the work of Davis, in the article previously referred to, on similar closed loops in cats. He found that cats survived much longer than dogs and finally died as a result of the distention and perforation of the loop, with consequent peritonitis. The characteristic toxin is nevertheless present and very active, killing dogs in small quantities with characteristic symptoms. The possibility of immunizing dogs suggested the idea that cats might possess a native immunity against this particular poison. The truth of this conception is borne out by the fact that Davis has failed to kill any cat even by the administration of relatively huge doses of known toxic material.

It will be observed that our experiments have been conducted upon closed loops and not upon simple constrictions of the lumen of the bowel such as are usually encountered clinically. The purpose in proceeding thus, as already explained, was to eliminate some of the complex factors that render direct study of simple obstruction too intricate a problem to control sufficiently. The next step is to determine whether the facts discovered in regard to closed loops can be carried over to apply to simple constrictions, and then to correlate our whole series of studies with the problem of clinical obstruction. It may be mentioned that a dog recovering from a simple obstruction will show a high immunity against a subsequent closed duodenal loop. The physiological properties of bowel content obtained from several cases of clinical obstruction in the human make us sanguine of proving the identity of the toxin with a toxin in clinical cases of obstruction. Whether this is the chief or only deleterious substance to be reckoned with we do not as yet know. In any case, the resemblance between our loops and certain forms of clinical obstruction, for example volvulus and the usual type of strangulated hernia, is quite apparent, and suggests that these cases present the double problem of a simple obstruction plus a closed loop. The importance of placing an enterostomy opening as close as is feasible to an unrelieved obstruction is also a corollary to our observations, as otherwise a condition resembling a drained loop may develop between the enterostomy and the obstruction. The important finding of toxin within the mucosa of the loops, even when drained, sheds light on certain clinical facts that have heretofore been obscure. It is well known that occasionally after the relief of obstruction by enterostomy or otherwise, even when peristalsis emptied out the bowel content, the patient failed to respond as one would expect and died without appreciable benefit from the drainage. If one may assume the similarity of these clinical cases to our loop experiments, it is easy to see an explanation in continued absorption from the mucosa, in a patient already so intoxicated that this continued absorption was sufficient to overwhelm him.

It is not meant to infer that drainage of the bowel is not logical and necessary; the vast array of clinical facts does not need the prolonged life of our drained dogs to prove a matter that is one of simple mechanics and common sense. But it is permissible to assume that drainage alone is not always sufficient. The escape of bowel contents voids a mass of toxic material, but there is still the toxin within the mucosa to be considered. In dealing with this we wish to give emphasis to the opinion of Hartwell and Hoguet on the importance of introducing ample quantities of fluid into the system by infusion, etc. We explain the effect of this procedure somewhat differently from its chief advocates, as we believe that it may be a dilution and increased elimination of the toxin, and perhaps the checking of a secondary dehydration caused by the toxin; whatever the explanation the method is good. But we hope that we have within our grasp a more direct defence against the perverted mucosa which we believe to be the fundamental trouble. We refer to the experiments we have made with the injection of extract of immunized liver into dogs with closed loops. While still inconclusive, our results have encouraged us to hope that we have a method of direct protection against the specific intoxication that causes death. The great value of such an adjuvant to the necessary mechanical relief of obstruction, both before and after operation, need scarcely be emphasized.

Conclusions.—In dogs one may isolate by double ligatures a loop of the duodenum and high jejunum and re-establish the continuity of the alimentary tract about the closed loop: such a condition is rapidly fatal.

The conditions of the experiment may be so controlled as to exclude circulatory disturbances, food derivatives, gastric, pancreatic, and biliary secretions as possible causes of death.

The dogs die with characteristic symptoms and present typical autopsy findings, the whole course of the post-operative disturbances suggesting an intoxication of some sort.

A fluid collects within the closed loops that is highly toxic, producing, when injected into normal dogs, a reaction much like that of dogs with closed loops. This toxin is believed to be the cause of death.

The toxin is formed by the mucosa of the closed loop, some of it being secreted into the lumen and some remaining within the cells of the mucosa.

If the closed loops be drained externally, the post-operative course of the animal is altered, but varying degrees of intoxication still are observable, and the presence of toxin within the mucosa of the drained loops is demonstrable.

Absorption takes place not only from the loop contents but from the mucosa direct, the latter being a quite important source of intoxication.

There are various possible explanations for the perversion of function that causes the mucosa to become a source of intoxication, but none are yet proved. The fundamental explanation of the change is as yet unknown.

It is possible by the repeated injection of sublethal amounts of the toxin to immunize dogs against fatal doses.

The parenchymatous organs, spleen, intestinal mucosa, etc., and particularly the liver, seem to be especially concerned in the production of the resistance against the toxin when dogs are immunized.

The extract of an immunized dog's liver, properly handled, will destroy the toxin *in vitro*.

We believe that the intoxication observed in closed loops is quite similar to that existing in simple obstruction, and that the same toxin is the essential agent causing death in each instance.

The discovery of the importance of absorption from the mucosa even in drained loops leads one to think that the establishment of an enterostomy for drainage in clinical cases may not meet all the requirements for successful treatment.

It may be possible to develop a method of direct defence against the toxin, as an auxiliary to the surgical relief of obstruction conditions.

SARCOMA OF THE SMALL INTESTINE.*

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THE clinical and pathological aspects of sarcoma of the small intestine have been thoroughly reviewed in the comprehensive papers of Baltzer, Rheinwald, Lecene and Libman. While little can be added to their conclusions, the writer desires to report two new cases and to summarize the results of operation in the large number of cases which are now on record.

A statistical review of sarcoma of the intestine proves the rarity of the affection, as Baltzer in 1894 was able to collect 14 cases, Libman 59 cases in 1900, and Lecene 89 cases in 1904. The autopsy records in various large hospitals also confirm the view that sarcoma is infrequent in the intestinal tract, especially when compared with carcinoma. Nothnagel found 243 instances of carcinoma of the intestine in 2124 autopsies on cancer cases, while of 243 sarcomata but three were in the bowel. Smoler in 13,036 autopsies found 13 cases of primary sarcoma of the small intestine. Sarcomata of the large intestine, excluding the rectum, are much less common. Of Krueger's cases, 16 occurred in the small intestine, 6 in the large intestine and 16 in the rectum. Jopson and White, in 1901, found 22 cases of the large intestine, whereas Libman's paper appearing a year earlier contained 59 cases of sarcoma of the small intestine.

Sarcoma of the small intestine does not appear to affect any particular age, although Baltzer found that the majority of his cases occurred in the fourth decade. The 75 cases in which the age is mentioned may be divided as follows: 1–10, nine; 10–20, ten; 20–30, seventeen; 30–40, eighteen; 40–50, fourteen; 50–60, five; 60–70, two.

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* Read before the Philadelphia Academy of Surgery, January 5, 1914.

The rather large number of cases occurring at an early age is a fact of much interest. The tumor in Stern's case was present at birth and caused intestinal obstruction from which the child died. In addition to this instance, sarcoma of the intestine has been observed in children of five and six years of age for which successful operations have been performed (Power, Barling, Zwalenburg).

Any portion of the small intestine may be the seat of a primary sarcoma. The following is an analysis of 53 cases in which the part involved is mentioned. As many of the case reports merely state that resection of the small intestine was performed, they could not be included. Duodenum and jejunum, 3; jejunum, 12; jejunum and ileum, 2; ileum, 32; entire intestinal tract, 4.

All writers on the subject mention the predisposition of the male sex in intestinal sarcoma. Adding the cases which I have collected to Lecene's we find of 101 instances, 67 occurred in males and 34 in females, or practically twice as many in the male sex.

As lymphosarcoma constitutes one of the chief types of intestinal sarcoma and as such growths tend to spread early to the neighboring lymphatic nodes, the mesentery of that portion of a bowel in which the sarcoma arises is involved frequently. In 45 autopsies 34 (75 per cent.) instances of mesenteric involvement are recorded by Lecene, a fact demonstrating the importance of thorough removal of the mesentery of the affected bowel. On the other hand metastasis to the superficial lymph-nodes or those in the retroperitoneum or mediastinum is rare.

Involvement of practically all the abdominal viscera has been noted in advanced cases, although the liver and kidney are especially liable to metastatic deposits. Direct extension to the peritoneum of adjacent viscera is quite common, and at the time of operation several loops of gut may require resection. Involvement of the bladder is met with frequently because the tumor in many cases occupies a pelvic position.

The histological variety of sarcoma is of great interest in connection with the question of metastasis. The majority of recurrences or metastases have arisen in lymphosarcoma or in the round-cell variety. The spindle-cell sarcoma, on the other hand, has a pronounced tendency to remain localized. This fact is explained partly by reason of the stenotic action such tumors exert on the intestine, in consequence of which the indications for early operation arise before marked extension can occur.

The association of single traumatic insults has long been held important in the development of sarcomata in general. The numerous instances recorded by Coley, Lowenstein and others support this view. It is not surprising, therefore, that such a factor is mentioned in some of the reported cases and is of particular interest, as the disease occurs much oftener in the working class. Zwalenburg records an abdominal injury in a boy aged five; six weeks later a tumor one inch in diameter was noted at the site of injury. Nothnagel observed a case of lymphosarcoma developing on the base of an old tuberculous ulcer. The association of tuberculosis and lymphosarcoma elsewhere has been observed and is regarded as an accidental association. Three cases of sarcoma have been reported to have occurred in the ileum years after severe attacks of typhoid fever. Firth noted an instance developing five months after an operation for strangulated hernia. Syphilis has also been present in several cases.

From these factors of more or less etiological importance, we are unable to draw any conclusions which might throw light upon the cause of intestinal sarcoma.

Kasemeyer has investigated very thoroughly the subject of intussusception caused by tumors, and has collected 284 cases, of which 85, or 30 per cent., were caused by malignant formations. Of these 85 cases, 57 were carcinoma and 26 were sarcoma. The symptoms of intussusception as seen in children, the severe abdominal pain, vomiting, bloody and mucous stools, are seldom present in intussusception secondary to tumor formation. In such cases a chronic course is pursued and the symptoms extend over months even with an intussusception present, as is demonstrated by the dense adhesions about the bowel or by extension of the invaginated tumor to the intestinal wall with which it comes in contact. The infrequency of complete obstruction following tumor intussusception is explained by the fact that the infiltrated intestinal wall undergoes dilatation.

Tenesmus may be the chief symptom complained of, but is as inconstant as is meteorismus and abdominal tenderness. The presence of a sausage shaped tumor, the situation of which varies, along with other symptoms of chronic intestinal obstruction, has been regarded as distinctive of tumor invagination by several observers, and the diagnosis correctly made (Ewald, Kasemeyer).

Many varieties of sarcomata have been observed in the intestine; the 99 cases in which the type is mentioned are divided as follows: Lymphosarcoma, 34; round-cell sarcoma, 43; spindle-cell sarcoma, 13; fibrosarcoma, 3; mixed-cell sarcoma, 1; myxosarcoma, 2; myosarcoma, 2; melanotic sarcoma, 1.

The lympho- and round-cell sarcomata greatly predominate. Many cases diagnosed as round-cell sarcoma probably belong to the lymphosarcoma group, but the histologic descriptions are too incomplete and indefinite in many cases to make the classification correct.

The tumors in the majority of cases originate in the submucous tissues (lymphosarcoma) or in the connective tissue of the muscularis or perivascular region, and in some instances reach a considerable size without producing any ulceration of the mucous membrane. They may extend parallel to the long axis of the bowel, producing a gradual infiltration of all the tissues but not causing stenosis. The bowel above the area of infiltration frequently undergoes dilatation and resembles an aneurism; the lumen of the intestine, in such cases, is filled with necrotic tumor tissue, pus and fecal material. Dilatation of the intestine is seen in the round-cell and lymphosarcomata, whereas stenosis and obstruction result from the fibrosarcomata. In exceptional cases the tumor extends through all the coats of the gut, gradually involving neighboring coils and forming a large adherent mass. The tumor may be single or multiple; in the latter event the growths appear as plaques or small nodules under the mucosa. The single tumors, especially if pedunculated, are singularly prone to produce intussusception, although this complication has developed in the infiltrative types of tumor.

Marked variations exist in the size of the tumors, although as a rule the growth has reached considerable proportions before the diagnosis has been made or the operation performed. The shape is spindle, the contour irregular and the consistency firm in most cases.

Although partial occlusion of the bowel is present in about one-half of the cases complete stenosis practically never develops from the mere presence of the sarcoma. Even in large tumors encroaching upon the intestinal lumen, a narrow passageway can be demonstrated, thus explaining the chronic intermittent symptoms of intestinal obstruction. When complete occlusion occurs and is followed by the symptom of ileus, the condition is caused by adhesions or by an intussusception.

Sarcoma of the small intestine manifests itself in the beginning by symptoms of an indefinite nature. In the majority of patients generalized abdominal pain is first noted; this is followed by loss of appetite, nausea, vomiting, the bowels are irregular, diarrhœa alternates with constipation, and distention of the abdomen soon follows. The patients are very thin, pale and weak, when first seen. Moderate elevation of temperature and slight leucocytosis may be present. Unless the acute obstruction is due to kinking of the intestine or to an intussusception, complete constipation is unusual, although repeated attacks of obstinate constipation may be complained of. Baltzer and Nothnagel both asserted that apart from complications, sarcoma of the intestine does not produce symptoms of stenosis. This view has been disproved by subsequent articles, in which it has been shown that at least 55 per cent. of the cases do have symptoms indicative of some degree of intestinal obstruction, but the course is not similar to the stenosis caused by cancer of the bowel. When carcinoma produces an obstructive lesion, the course is generally a protracted one and the patient's loss of strength and weight is slow and gradual. Sarcoma, on the other hand, causes rapid loss of weight, the disease rarely lasting over a year and the average duration, according to Rheinwald, being four to five months.

A careful study of the histories of many cases shows that attacks of constipation and diarrhœa are common, although these symptoms are wanting in a small proportion of the cases. It is also worthy of note that in many instances vague intestinal disturbances are the earliest symptoms noted, and that operation performed a few weeks or months later will often reveal a larger or even inoperable sarcoma.

Blood in the stools has been present in a small proportion of the cases, and is sometimes one of the earliest symptoms mentioned.

In a few instances the patients have noted the presence of a tumor. This on examination varies considerably in size, the surface is smooth and nodular, and unless seen quite late, the growth is freely movable. Its consistency is as a rule dense and hard. In late cases metastatic nodules are palpable and the primary growth demonstrated with difficulty.

As the result of pressure of the tumor on the intestine, distention may result, and pressure on the vessels may produce ascites, or œdema of the legs, distention of the veins of the abdominal or thoracic walls, jaundice, dysuria or diminution in the amount of urine (Libman). Examination of the blood shows merely a secondary anæmia.

Libman has classified the varieties of the disease as follows: (1) Latent cases, the disease being first discovered at autopsy. (2) Cases with the clinical picture described by Baltzer, either the general symptoms, the distention of the abdomen, or the tumor being first noted. (3) Cases in which the first symptoms are due to an intussusception or other variety of intestinal obstruction or to perforation. (4) Cases resembling tuberculous peritonitis. (5) Cases in which jaundice is the first symptom. (6) Cases resembling ovarian cysts. (7) Cases bearing a close resemblance to appendicitis, an observation noted first by Libman and described in several reports since that time.

An early diagnosis in these cases seems impossible because the symptoms are so mild and transitory in the beginning. When, however, a tumor is discovered, freely movable, producing pressure symptoms of a mild type, with the absence of severe obstruction symptoms, sarcoma of the small intestine should be suspected.

The treatment of intestinal sarcoma is of course surgical, although in inoperable lymphosarcomata benefit has been followed by the administration of arsenic. Libman recommended its use even in cases in which successful resection of the intestine has been performed.

For a long time sarcoma of the intestine was regarded as almost invariably fatal. This view is not sustained by an analysis of the cases reported in the past decade, in a large number of which many years have elapsed without recurrence since the time of operation. The vague nature of the symptoms delays operation, although a palpable tumor is almost invariably present at the time of operation and a history of a chronic intestinal disturbance can be obtained in the majority of cases.

The number of resections of the small intestine for sarcoma is 75; of these 15 are collected by Zwalenburg, 37 by Moynihan, 6 by Lecene, 17 by Speese. There were 55 recoveries (74 per cent.), and 19 deaths following operation. Nine instances of recurrence are noted, the periods varying from three months, 5 months (2), 12 months (2), 15 months. The cases in which recurrence arose in 7 instances were diagnosed as lymphosarcoma or round-cell sarcoma, thus emphasizing the malignant nature of this variety; one case of myxosarcoma recurred.

When the infiltration of the bowel is too extensive for removal or metastasis has occurred, the abdomen should be closed without further exploration. If stenosis is present some surgeons advise an artificial anus to relieve the immediate and urgent symptoms.

The large number of intussusceptions noted in the series is a matter of considerable interest and importance. In 14 of the 74 resections, this complication was encountered. Ten of these 14 cases recovered, 1 died immediately after operation, and 3 from recurrence. The type of tumor has no influence upon the development of an intussusception, for the complication has occurred in the round-cell, the lymphosarcoma and other forms. A pedunculated tumor may predispose to invagination, but it also follows cases in which the intestinal wall is extensively infiltrated by the tumor.

The amount of small intestine resected in the majority of cases is from 10 to 40 cm. Barclay removed 190 cm., and Storp 510 cm. of the bowel. In the former case the patient suffered from frequent and liquid stools, and in the latter no metabolic or other disturbances were noted.

The effect of the removal of large amounts of small intestine has been investigated experimentally by Flint, whose conclusions are of great importance in view of the radical measures which may have to be undertaken in some of the cases. It was found that in dogs as much as 50 per cent. of the total intestine may be removed without fatal results, and the animals may gradually return to a condition of practically normal weight and metabolism when maintained on a favorable diet under good conditions. Resections of 75 per cent. or more of small intestine may be survived, but such animals do not show a return to normal weight with the establishment of a good compensatory process.

Animals at first suffer from a severe diarrhœa, ravenous thirst and appetite, and loss of weight, from which they gradually recover until conditions may return to those of a normal animal. They remain extremely sensitive to unfavorable conditions of diet and living.

The compensatory process consists in a hypertrophy and hyperplasia of the remaining portion of the small intestine. There is no regeneration of villi or crypts.

Human cases behave in general like animals and show similar metabolic disturbances. There are over 58 cases in the literature in which over 200 cm. of small gut have been resected. The mortality is 16 per cent., which is lower than it should be, as only the successful cases have probably been reported. Metabolic disturbances in human beings bear no definite relationship to the amount of small intestine resected.

Resection of over 400 cm. of intestine has been followed by recovery, while death from inanition has resulted from resection of 284, 289, 300, 380 cm. respectively.

Profound digestive disturbances have resulted from removal of 192 and 204 cm. of ileum.

Progress in human cases should be guarded. Apparently successful resection may, for lack of suitable compensation, succumb ultimately to a slow process of inanition. Experiments and series of human cases emphasize the fact that neither the stomach nor the colon is able to compensate for the loss of large portions of small gut.

The writer desires to express his thanks for permission to report the following cases, operated upon by Dr. John B. Deaver at the University Hospital.

Male, aged fifty, has been suffering with hemorrhoids for several years and for the past several weeks has complained of constipation, distention of the abdomen, severe cramps and vomiting. The constipation was relieved by enemas and laxatives, the resulting movements were as black as ink, although free blood was not noticed. He has had successive attacks of pain, tenderness and obstinate constipation. The mass was not discovered until the time of examination, seven weeks after his symptoms began. The examination disclosed a round mass in the right lower quadrant of the abdomen. The tumor is tender, regular in outline, and is movable.

Blood examination, red blood cells 4,980,000, polynuclears 70, white blood cells 9,800, lymphocytes 20, hæmoglobin 100, monoleucocytes 0, transitionals 1, eosin 0.

Examination of the fæces for occult blood was negative.

Operation.—A large mass about the size of an orange was found in the ileum about 3 feet from the ileocæcal junction. The ileum was resected with its corresponding portion of mesentery, and end-to-end anastomosis was performed. Five days after the operation the patient developed a fecal fistula; this was followed by peritonitis, from which he succumbed eleven days after the operation.

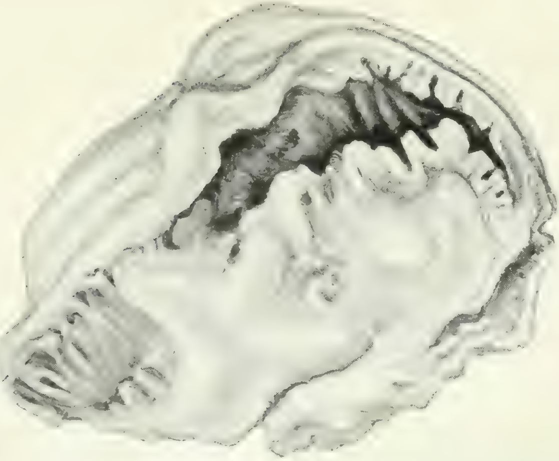
Pathological Examination.—The specimen consists of 57 cm. of ileum. The intestine at one area contains a globular mass 8 cm. in diameter, the wall of the intestine is enormously thickened, measuring 3 cm. The section through this thickened portion shows that the intestinal mucosa is greatly ulcerated and that the lumen of the bowel is represented merely by an irregular area of ulceration through the centre of the tumor mass. At one point the lumen is almost completely occluded by the tumor tissue (Fig. 1). The tumor mass, as represented by the greatly infiltrated wall of the intestine, is composed of firm whitish tissue which is completely surrounded by the serous coat of the intestine. In the mesentery several enlarged nodes having the same characteristics as the primary tumor are found.

Microscopic examination shows a very cellular formation composed of small, round, deeply staining cells, having a fairly uniform appearance. The stroma is composed of thin fibrils which ramify between the tumor cells, which extend to the mucosa and infiltrate and destroy the intestinal glands. The structure of the muscular coats of the intestine is completely obliterated by the cellular infiltration. The tumor contains very minute areas of necrosis and is fairly well supplied with new blood-vessels. The lymph-nodes removed from the mesentery show a similar involvement.

Diagnosis.—Lymphosarcoma.

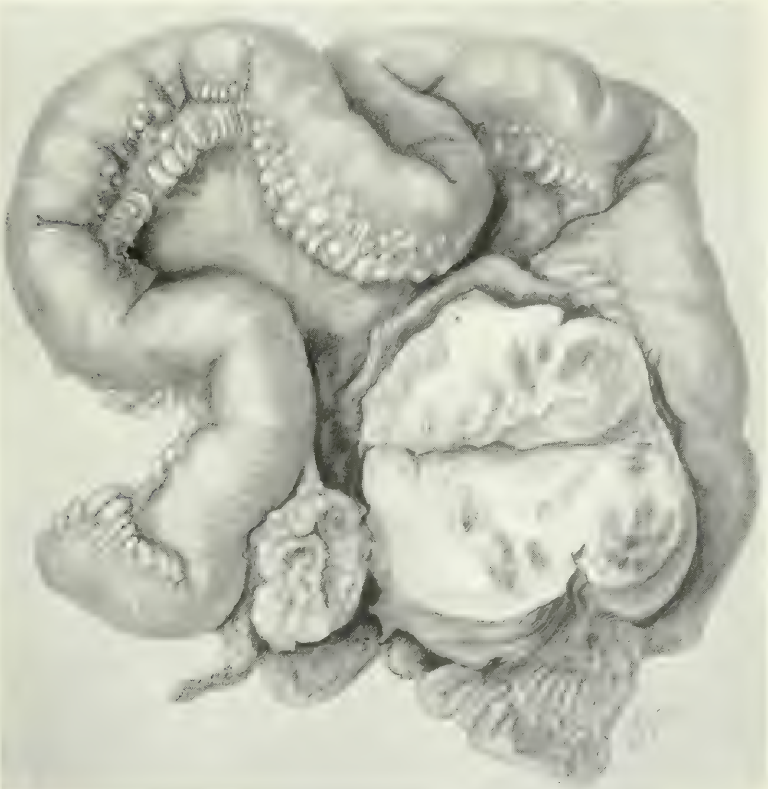
Female, aged fifty-seven, was admitted to the University Hospital complaining of pain in the abdomen. Her past medical history is unimportant. One sister died of cancer of the stomach. Her present illness began one month before her admittance, when she was suddenly seized with agonizing pain in the abdomen. The pain was localized to the region of the umbilicus; the attacks were accompanied by vomiting. The attack lasted twenty-nine hours. The patient recovered and was well for a period of three weeks, when the pain again returned. The pain has been persistent, is constantly localized to the region of the umbilicus; the bowels are regular; there has been some distention of the abdomen. On examination a mass the size of a grape fruit is palpable in the lower and middle portion of the abdomen. The upper limit of the tumor is about one inch below the umbilicus.

FIG. 1.



Lymphosarcoma of intestine showing partial occlusion of the lumen.

FIG. 2.



Myxosarcoma of mesentery.

The mass is smooth, round and slightly movable. Red blood cells 3,710,000, polynuclears 70, white blood cells 20,000, lymphocytes 23, hæmoglobin 60, monoleucocytes, 3, transitionals 4, eosin 0.

Operation.—On opening the abdomen a mass was found in the mesentery, in the midline; the surrounding coils of intestine were attached to it by adhesions. The coil of ileum which surrounded the tumor and the mesentery were excised and a lateral anastomosis formed. A supravaginal hysterectomy was performed for a large subserous fibroid tumor. Recovery; no evidence of recurrence three months after operation.

Pathological Examination.—The specimen consists of a tumor which is surrounded by a loop of small intestine, which measures 80 cm. in length. The tumor, which measures 8 cm. in diameter, is situated near the base of the mesentery and is attached to the intestine for a distance of a few centimetres only. The wall of the intestine appears normal and is not compressed by the tumor mass. On cross section the tumor is soft in consistency, the cut surface for the most part is white and contains numerous reddish areas and small points of necrosis.

On microscopic examination the growth for the most part is composed of tissue containing large stellate cells. The connective tissue in these areas is of very loose texture, and contains within its meshes a homogeneous substance taking a faint blue stain. Large numbers of blood-vessels with thin walls are present. A considerable amount of free blood is found in the fibrous tissue. In addition to the stellate cells mentioned, there are many areas in which large numbers of cells are closely packed together, the cells being spindle in type, some are large, some small and many being arranged around the blood-vessels. Minute areas of necrosis are encountered, and in these situations leucocytes are found between the tumor cells. Many nonstriated muscle fibres are seen in the more superficial portions of the tumor.

Diagnosis.—Myxosarcoma of mesentery.

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THE SURGICAL TREATMENT OF ACUTE GONORRHŒAL EPIDIDYMITIS BY EPIDIDYMOTOMY.

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ALTHOUGH in the hands of a few genito-urinary surgeons epididymotomy has become the treatment of choice in acute gonorrhœal epididymitis, it has not as yet reached as full an appreciation as the operation seems to warrant. It is an axiom of surgery to-day, that when the function of an organ is threatened by the invasion of pus-producing organisms, prompt incision and drainage are indicated.

During the past five or six years, I have been doing this operation as described by Hagnar, of Washington, on only such of those cases as have come under my care, having unusually severe pain, with considerable swelling and high temperature. In all of these cases the results were so satisfactory that I was led to the idea of applying this treatment consecutively to all the acute cases during two and a half months last summer, when I had the care of the service at Bellevue Hospital, with which I am connected.

The astonishingly happy outcome of this experiment, as far as immediate results were concerned, seems to justify a short review of the methods employed in this small collection of twenty-one successive cases. It gives me pleasure to acknowledge the assistance and valuable suggestions of Dr. George F. Cahill, of the house staff, who did this work with me, and who deserves much of the credit for putting this small operation on a technically simpler basis than it has, I think, previously enjoyed. It is on account of the simplicity of this operation and its apparent freedom from risk, also the firm conviction that the course of the disease is shortened and the liability of sterility is lessened, that I am here adding a record of my experience to the list.

The frequency with which this complication of a gonococcus infection occurs, its obvious diagnosis, the distracting character of the pain, the attending fever, its debilitating and often protracted course, the unsatisfactory nature of medical treatment and the considerable percentage of following sterility are all so well known and so well described in standard text-books, that there is no need for repetition here. The simple method we employed was as follows:

The patient was prepared for an ether anæsthesia. Just as soon as the patient was lightly under, the operative field was sterilized with 2½ per cent. tincture of iodine, and an oblique incision, 1½ inches long, was made downward and forward over the epididymal swelling, which in our series of cases occurred uniformly in the globus minor. With the oblique course of our incision it was possible to avoid most of the small vessels in the skin and thus get very little bleeding.

The incision was carried down to the tunic vaginalis, which was opened to the length of the skin incision and the fluid, which was usually present, drained off. The edge of the tunic was picked up on both sides with hæmostats, which acting as retractors bared the swollen and congested epididymis; its thickened fibrous covering was incised for one-half inch over the prominence of the swelling and a probe gently passed into the substance of the epididymis, in several directions. If suppuration had occurred, the pus was in this way easily found and drained off. In all cases relief of tension was effected and drainage established.

The most important element in this operation is the lack of traumatism, as the testicle is not delivered or the parts bruised from handling. In that smaller percentage of cases where the body of the epididymitis or the globus major is involved, a freer incision and possibly a turning out of the testicle will be found to be best, but the special point of this paper is to show how little of an operation is necessary in the great majority of cases, and the little excuse there is to allow these patients to suffer the pain, the slow convalescence and possibly sterility for want of a prompt decision in draining this dependent point of infection.

A wick made of rubber dam was gently placed in the substance of the epididymis, where the probe found least resistance, or into the cavity made by the accumulation of pus, if pus was present.

In 33 per cent. of the cases pus was present. The gonococcus was the only organism found. One or two catgut sutures were then used to draw the deeper structures together, and two or three silk-worm sutures closed the skin except for about a half inch opening through which the drain emerged. The time of operation was usually from five to ten minutes. A generous dressing was held in place by an Alexander suspensory.

The immediate relief from pain and the decline in temperature was the pleasing aftermath of each operation. In forty-eight hours the drain was removed and the parts so exquisitely tender before operation could be handled without discomfort.

On the fourth or fifth day the patients were allowed up, and on the fifth or sixth day the stitches were removed and the patient allowed to go out.

This form of treatment is indeed in striking contrast with the older methods, where the patient lies in bed with his scrotum resting on a supporting bridge, stretched between the thighs and surmounted by heat, cold or chemicals, wincing at the approach of attending hands and patiently waiting, while the severity of pain was dulled by anodynes, the slow restitution of the swollen gland.

It is difficult as yet to tell the end value of this little surgical procedure, which secures such immediate relief. What is radical to-day often becomes conservative to-morrow. We may hope as much for this way of dealing with acute epididymitis, for with practically no risk, it saves a deal of suffering and lost time in tedious convalescence.

It is impossible with the class of patients dealt with at Bellevue Hospital to hope for co-operation in the after-study of these cases.

The pathology of the condition as it exists and as it is dealt with expectantly is well known and equally unsatisfactory. To get the relative value of the newer way of dealing with this complication, must needs take patient and scientific study over a period of subsequent years.

In a paper read by Cunningham, of Boston, before the American Association of Genito-Urinary Surgeons in Washington, last spring, of his series of cases he reported having operated bilaterally on six. Two of these patients have married and each of them has had two children. This is interesting as not only showing potency, but the fact of their having had two children is evidence that they probably did not infect their wives. Two others of these six cases showed numerous living spermatozoa in condom specimens collected at coitus; but no spermatozoa were seen in specimens collected by massage of the seminal vesicles and prostate. The remaining two had had no sexual intercourse and the specimens collected by massaging the seminal vesicles showed no spermatozoa.

With the knowledge we have at hand it seems unlikely that this operation, when properly done, that is without further destruction of the tissue than the disease has already effected, cannot but shorten the course of the pathological process and bring to the organ a better chance of ultimate recovery. Whether the organisms are recovered from the exudate which nature has produced by her processes and which we release by the knife, is of very little moment.

The real question is, do we lessen or obviate by epididymotomy that sequel of the disease, which so often leaves the testicle with the pathways of its spermatozoa blocked—in permanent bondage?

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held January 5, 1914.

Dr. Gwilym G. Davis, President, in the Chair.

TUBAL PREGNANCY.

Dr. A. D. Whiting reported the following case:

L. L., a white female aged nineteen, was admitted to the Germantown Hospital, November 22, 1913. Her history states that she was married when 15 years of age and that she gave birth to a normal child 3 years ago. Her menstrual history dates back 7 years. Her menses were regular but very painful and the flow was always profuse. Her last menstrual period started April 7, 1913, and lasted 4 days, being normal in every respect. There has been no vaginal bleeding or discharge of any character since that time. She began to have the nausea and vomiting of pregnancy in May and also had pains in the lower abdomen which were intermittent in character. These were similar to pains she had had while carrying her first child, although she thought them more severe. Fetal movements had been felt for more than two months before admission and had been unusually severe and painful on the day of admission. The patient had noticed practically no difference between this pregnancy and her former one and had made arrangements for her delivery in January.

At 11 A.M., November 22, 1913, after returning home from shopping, she made and ate a sandwich which she says caused marked nausea followed by vomiting and retching and severe pains, of a lancinating character, in the lower abdomen. She became faint and felt very cold, weak, and thirsty. She drank considerable water, which she immediately vomited. The symptoms continuing, her physician, Dr. Sutliff, was called. He immediately sent her to the hospital as a case of concealed hemorrhage.

On admission, the lips and conjunctivæ were blanched, the skin was pale, the breathing was rapid and shallow, the pulse was thready and too rapid to be counted accurately. Patient complained of extreme thirst, was very restless, and showed great excitement in her facial expression.

Examination revealed a large, rounded mass extending from the pubes to above the umbilicus slightly to the right of the median line. Percussion elicited dulness over the entire right side of the abdomen, present but not so marked on the left side. Vaginal examination revealed an enlarged uterus with a soft cervix. The fundus could not be distinguished; the uterus seemed to be continuous with the abdominal mass, which moved freely with the cervix. There was no vaginal discharge. No fetal movements could be felt; fetal heart sounds could not be heard. The temperature was 97° F.; respirations, 48; pulse rate approximately 160. A diagnosis of internal hemorrhage was made and immediate operation advised.

Operation at 3 P.M., November 22, within 4 hours after the onset of the alarming symptoms. Under ether anæsthesia, an incision was made through the right rectus. The right iliac fossa was filled with an enormous blood clot, while clots and fluid blood almost filled the peritoneal cavity. Rapid removal of the blood allowed an examination of the tumor which presented. It was found to be a globular mass springing, apparently, from the right broad ligament and containing a hard, irregular body. It was freely movable; there were no adhesions between it and any surrounding structure. On its surface were many broad, flat ribbon-like vessels, one of which was bleeding freely but without pulsation. The tumor was attached to the right broad ligament and to the right cornu of the uterus by a short portion of the right fallopian tube; the right ovary was to the right and below; the fundus of the uterus was below and to the left; both ovaries and the left tube were apparently normal. The right tube had apparently entirely disappeared in the tumor.

The broad pedicle of the tumor was ligated and the tumor removed. The abdomen was flushed with hot saline solution and the wound was closed in tiers without drainage. Two thousand c.c. of salt solution were given intravenously during the operation and one-half grain morphia was administered hypodermically.

The patient reacted well from the operation. Examination of the blood twenty-four hours after admission showed a hæmoglobin of 21 per cent.; red blood cells, 2,460,000; and white blood cells, 18,600. The temperature rose to 101.6° F. after the operation and continued between 99.6° and 103° for 15 days, although no cause for the continued fever could be found. The wound healed without infection; the lungs remained normal; there was no cardiac complication; there was no phlebitis; there were no signs of peritonitis. Forty-eight hours after operation the patient expelled from the vagina a mass that seemed to be a cast of the inside of the uterus. With this exception, there was no uterine discharge. At 5 P.M. on the fifteenth day after operation the temperature was 103° F.; at 5 A.M. on the sixteenth day, it registered 98.6°, and remained between 98° and 99° until the patient was discharged from the hospital on the twenty-eighth day after operation.

The tumor weighed, immediately after operation, 3670 grammes and measured 68 cm. in its longest circumference. An X-ray picture revealed the bony structure of a well-developed fœtus.

Study of the specimen after it had been opened and hardened in formalin solution gives the following findings. The gestation sac is, in part, membranous and in part occupied by a thick, friable, spongy mass, evidently placental tissue. The sac varies in thickness from 0.1 cm. in the thinnest membranous portion to 4 cm. in the thickest part. The fœtus measures 40 cm. in length. It is a well-formed female covered with vernix caseosa and in no ways differs from the usual normal fœtus. The cord, which is 55 cm. long, is not attached immediately to the placental area, but is inserted into the membranous portion of the sac at a distance of about 3 cm. from the placental margin. From the insertion of the cord a number of large, thin-walled, tortuous vessels radiate in all directions and ultimately find their way to the placental area. Some of the vessels leading from the cord run on the inner aspect of the sac and some on the outer. One of the external vessels presents a small rupture of its thinned-out wall.

Microscopic examination of a section through the thin membranous portion of the gestation sac shows stratified fibrous structure rather well vascularized and lined internally by the amnion. There is no apparent muscular tissue in this portion of the sac.

Microscopical examination of a section through the thicker area shows typical placental tissue of the later months of pregnancy, which is implanted upon a thick lamellar structure composed chiefly of concentric layers of fibrous tissue in which can be seen what are apparently bundles of smooth muscle. The attachment of the placenta to this fibromuscular wall is not an immediate one, but is obtained through the medium of a layer of large vesicular cells which bear considerable resemblance to decidual cells. This layer varies in thickness in different portions and in some parts spreads out into thin strands which are themselves separated by fibrous bands.

Dr. Whiting remarked that this case was of more or less interest on account of the length of gestation; and on account of the termination, rupture of the vessel on the outer aspect of the wall of the gestation sac without any rupture of the sac wall. The absence of symptoms of tubal pregnancy might be noted, as well as the perfect freedom of the tumor within the abdominal cavity, there being no restriction other than its attachment to the broad ligament and the cornua of the uterus.

Although Tait, in his memorable articles on the subject of tubal pregnancy, claimed that primary rupture of the sac of a tubal gestation occurred at or before the fourteenth week, numerous cases greatly exceeding this period, without rupture, have been recorded. The average length of tubal gestation, without rupture or the expulsion of the embryo through the fimbriated extremity, however, is much less than that recorded in this case. Thus Webster quotes Henning as having reported 95 cases of tubal pregnancy in which rupture occurred in 80 per cent. before the sixth month. In this series of cases, 1 ruptured in the sixth month; 1 in the seventh; 6 in the eighth; 1 in the ninth; 9 in the tenth, and 1 beyond the tenth month. In Von Schrenk's 141 collected cases, in Schauta's 87 cases, and in Mackenrodt's 38 cases, rupture took place in every instance before the expiration of the fourth month (quoted by Webster).

At the German Hospital, during the last ten years, there have been 128 cases of tubal pregnancy. Operations in these cases were performed by Dr. J. B. Deaver, to whom he was indebted for the privilege of citing them, by Dr. G. G. Ross or himself. In 99 of these patients, rupture through the wall of the tube had taken place; in 10 the products of gestation, in whole or in part, had been expelled through the fimbriated extremity; and in 5 there had been bleeding from the fimbriated extremity at or before the time of operation. Fourteen cases were operated upon before rupture or bleeding had taken place.

Among the cases that ruptured, aborted, or bled from the fimbriated extremity, the catastrophe occurred in 3 during the first month; in 57 during the second month; in 30 during the third month; in 13 during the fourth month; and in 2 during the fifth month. In 9 cases the period of gestation was not stated.

In a very limited search through the literature of tubal pregnancy, he was unable to find any reference to a termination similar to that recorded in this case. In all of the cases noted, there was rupture of the sac wall; expulsion through the fimbriated extremity; or free bleeding from the fimbriated extremity without expulsion of the gestation products. In this case there was a rupture of the wall of one of the ribbon-like vessels without any discoverable rupture of the sac. This rupture was possibly caused by traumatism during the violent vomiting and retching, although the vomiting may have been due to the ruptured vessel and not to the sandwich, to which the patient attributed it. If caused by the marked activity of the fœtus on the day of the rupture, it is probable that some signs of internal violence would have remained or that the sac itself would have been ruptured. Possibly the vessel had reached the extreme limit of stretching and could not be thinned out any more.

RECURRENT STONES IN THE URINARY BLADDER.

Dr. Harry P. Carmany, in presenting this case, said that he had reported it before to the Academy in 1911 as one of a rather large stone removed by spinal anæsthesia. At that time cystoscopy was ineffectual on account of size of stone, although sounding and X-ray discovered it. He was admitted to St. Timothy's Hospital October 11, 1911. He was fifty-eight years old. On admission complained of frequent urination and a sense of burning in perineum. Sound revealed stone, X-ray confirmed it. Removal under spinal anæsthesia; was in hospital 49 days, when he was discharged cured. He remained well until June, 1913, when he again began to have frequent urination and burning in perineum; July 10, 1913, he was again admitted to the hospital with a distended bladder. His condition was such that little time was consumed trying to pass instrument, and suprapubic drainage was immediately decided on. He was given chloroform, as his cough was still present which had determined the use of spinal anæsthesia at the first operation. On opening his bladder, a calculus was forced out and on examination another one was found loose in bladder and yet another impacted in the posterior urethra.

Dr. Alfred C. Wood said, in regard to the re-formation of stones, or stones thought to have been overlooked at the time of operation, if a patient has some obstruction to the emptying of the bladder, either prostatic or urethral, and particularly if he has infection of the urine with ammoniacal decomposition, stones may form in a comparatively short time. Also in a certain number of cases there may be stone lodged in the ureter which later coming down forms a nucleus for a larger stone. He recalled one case in which during a suprapubic lithotomy, after removing a great many stones, four ounces in all, one was found projecting from the ureteral orifice. This was removed, when another was felt and removed, and so on until five had been delivered from the lower end of the ureter. If these had not been discovered they might later have appeared in the bladder and given the impression that they had been left from the previous operation.

Dr. John Speese said that about three years ago he operated upon a boy two years of age, and removed three stones from the bladder by the suprapubic method. The boy returned to the Children's Hospital several months ago with renewed symptoms of vesical calculus, and another stone was removed by Dr. Wharton. The calculi removed at the first operation were phosphatic, octagonal in shape, smooth, and each was about the size of a small hickory nut. The stone removed at the second operation was about the size of an almond, mulberry in appearance and was composed of urates. After complete recovery symptoms of a stone in the kidney developed, and an X-ray corroborated the diagnosis.

Such a case demonstrates the possible recurrence of vesical calculi at an early age, although the subsequent history of a kidney stone points to this organ as the point of formation of the vesical calculi.

Dr. Addinell Hewson, in connection with the stones not being found, said that some years ago he found in a man whose history he obtained subsequently, eighty years of age, who came from an almshouse in the interior of the State, a completely encysted mulberry calculus about the size of an ordinary thimble, completely walled off from the bladder. It was just behind the symphysis pubis. The man had complained of no symptoms whatever of stone.

SARCOMA OF THE SMALL INTESTINE.

Dr. John Speese presented a paper with the above title, for which see page 727.

Dr. John H. Jopson remarked that in 1901, Dr. C. Y. White and he reported a case of sarcoma of the large intestine in a child of four years. They collected, as Dr. Speese had mentioned, 22 cases of sarcoma of the large intestine above the rectum, all that they could find in the literature at that time, and they excluded all cases in which there was not a reasonable certainty that the process was primary in the large bowel. Shortly before this Libman had collected 59 cases of sarcoma of the small intestine, and the difference in the number of cases in his series and in theirs represents fairly accurately the comparative percentage of frequency of sarcoma in these two portions of the intestine.

In the rectum sarcoma is more frequently met with than in either the large bowel or the small intestine, but its symptoms do not differ materially from carcinoma of the rectum; whereas, in the remainder of the large intestine, namely, the cæcum and colon, the symptoms are so strikingly different from carcinoma that the difference has been emphasized by all observers. This is due especially to the absence of obstruction in cases of sarcoma, an observation that is also true of sarcomata of the small bowel.

Dilatation of the affected region, either as a fusiform or sacculated dilatation, is the rule, although in some cases the bowel is converted by infiltration into a thick-walled tube. This dilatation has been explained by the early infiltration and paralysis of the muscular fibres. In only one of the 22 cases which they studied was complete obstruction present. In this case the tumor was of the spindle-cell type and situated in the descending colon, causing almost complete stenosis with impaction of the opening by a small fecal mass. In one other case of a round-cell sarcoma of the sigmoid flexure incomplete obstruction was present.

The lymph follicles in the mucosa or submucosa seemed to be the usual starting point in these cases, and from this region the tumor involved the other coats; the muscular offering the greatest, and the subserous coat, the least resistance. The serosa itself was rarely perforated. Dr. Speese mentioned the possibility of sarcoma developing in the subserous coat.

Their cases were almost equally divided as to sex. They ranged in age from 2 to 60. The first decade contained the greatest number, and the fourth decade the next greatest. There were only three cases over forty years of age. The duration in cases not operated upon varied widely; probably four to six months was the average after the tumor was detected. The mortality in cases operated upon has shown a great improvement since they collected their cases. At that time the mortality was 50 per cent. Of the cases recovering, one died of a quick recurrence. The other four were living at the time they were reported.

With our present familiarity with operative technic and the early performance of operation in abdominal tumors the mortality is no doubt at the present time very much below this figure.

Dr. John H. Gibbon said that he had never seen a sarcoma of the small intestine but was interested especially in the question of resection in this condition. As surgeons realize the importance of the small intestine as a digestive organ their respect for the stomach decreases. One may get along very well without a stomach, but it is difficult without the first portion of the small intestine. One may take out only a small amount, two or three feet, of small intestine, and the patient will suffer greatly from inability to digest his food. He had seen this even where he had only taken out 18 inches two or three feet away from the beginning of the jejunum. The diarrhœa will keep up for months and the patient will go down to a shadow. Most of his cases had been in tuberculous individuals. Two years ago in a case with an enormous lipoma producing intestinal obstruction he did a resection in order to remove the growth which at first he thought to be an inoperable retroperitoneal sarcoma; in this case it was necessary to resect a large amount of small intestine in order to remove the tumor, and he found himself within three inches of the jejunum, with just enough bowel to make an anastomosis, and he had removed 9½ feet of small intestine. This man for a short time had little disturbance, but for 18 months he was very sick; had diarrhœa, could not digest his food, everything gave him pain, he passed his food undigested, lost weight, and only in the last six months has the remaining portion of his intestine taken on the function of the resected portion, so that he is now getting better.

DEPOSIT OF METALLIC SILVER IN BODY TISSUES.

Dr. Addinell Hewson gave a preliminary notice of the fact that he had been able to deposit metallic silver in the glomerule of the kidney in cadavers. The process by which this was attained was by injecting into the aorta a 2 per cent. solution of nitrate of silver and a 5 per cent. solution of formaldehyde in distilled water. Immediately following this mixture, a 2 per cent. solution of ammonia in distilled water was injected and the deposit of silver could be seen increasing in the papillary layer of the skin, giving the subject a mottled appearance.

Dr. Hewson reported that at a subsequent meeting he would show specimens of this work with the various tissues, but desired to give formal notice of the fact that he had succeeded in making a deposit of metallic silver in the tissues.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, held at the New York Academy of Medicine, October 22, 1913.

The President, Dr. Frederic Kammerer, in the Chair.

TUMOR OF THE CAROTID.

Dr. Frank S. Mathews, presented a man, twenty-seven years old, upon whom he had operated two and a half years ago for a tumor of the carotid body. The man stated he had noticed all his life that there was a greater fulness in the left side of the neck than the right.

Dr. Mathews said he made an attempt to remove the carotid tumor, but its extirpation proved impossible because of its ill-defined character, the great vascularity of the surrounding tissues, and the infiltration of important structures. The man had remained in fairly good health and had continued at his usual occupation. The growth was still small, although perhaps fifty per cent. larger than at the time when the operation was attempted, two and a half years ago. At that time a section was removed for examination; it was pronounced an "alveolar sarcoma," the pathological picture closely resembling that described in other cases of this rare form of tumor.

This patient now presented all the important characteristics of this type of growth, which were largely explained by its vascularity and its origin at the bifurcation of the carotid artery, inside of the sheath. The involvement of the pneumogastric, hypoglossal and sympathetic nerves was shown by the paralysis of the left vocal cord, hemiatrophy and paralysis of the tongue, and contraction of the left pupil. The growth extended upward from the carotid bifurcation to the base of the skull and the anterior parotid region. The left side of the pharynx was pushed inward, the tonsil was near the middle line, and its pillars were œdematous. There was a bruit, synchronous with the heart beat, over the tumor and upon the cheek, together with a rather definite expansile pulsation.

At the time of operation the internal jugular in the lower part of the neck was empty, while the veins in the upper neck were much engorged.

The speaker said that the high mortality following the operation, the fact that at times it had to be abandoned, the dangers of carotid ligation and the rather characteristic symptom-complex emphasized the importance of diagnosis while the tumor was quite small, so that the operation could be done at an early stage, if at all. The exceeding difficulty of these operations was generally admitted. Though the tumor in this case was still small when the patient first came under observation, its removal was abandoned when it was found that the carotid, the internal jugular, important nerves, and the pharyngeal wall, would have to be removed. It would have been difficult to ligate the internal carotid above the tumor, which seemed to extend up to the base of the skull.

HYGROMA OF THE NECK.

Dr. Mathews presented a child, three and a half years old, that came under his observation with a tumor on the right side of the neck. The growth was soft and fluctuant, like an abscess. On operation, it was found that it extended down underneath the clavicle, and was made up of a number of compartments, like those in the cases described in the paper of Dr. Charles N. Dowd, which was published in the Annals of Surgery, issue of July, 1913.

HYGROMA OF AXILLA AND NECK.

Dr. William A. Downes presented a girl, nineteen years old, who was admitted to St. Luke's Hospital on September 8, 1913, with the history that ten months ago she first noticed a swelling in the right axilla, which gradually increased in size. It was not painful nor tender, but in the last few weeks it became so large that it interfered with the free use of the arm, and in this way gave rise to pain.

Examination showed that the entire right axilla was occupied by a cystic tumor extending upward behind the clavicle and displacing the left breast downward and forward. The overlying skin was not adherent and the growth was movable over the deeper tissues.

The growth was exposed through a transverse incision, to which a vertical incision was added, extending down from the centre. It was necessary to divide both the pectoral muscles in order to enucleate the growth, which was removed intact with the exception of one small loculus, which ruptured. The divided muscles were then sutured, and the wound was closed. The patient was discharged on September 20. The growth proved to be a hygroma.

SPLENECTOMY FOR SPONTANEOUS RUPTURE OF THE SPLEEN IN TYPHOID FEVER.

DR. WILLIAM A. DOWNES presented a man, thirty-six years old, a physician, who was admitted to the New York Hospital, in the service of Dr. Lewis A. Conner, on February 20, 1913, with the diagnosis of probable typhoid fever. Up to the onset of his symptoms, seven days before, he had never been seriously ill in his life. He had never had malarial fever nor any other disease likely to lead to enlargement of the spleen.

Upon examination, the abdomen was full and soft. No rose spots. Liver dulness extended in mamillary line from the sixth rib to the free border. The edge of the liver could not be made out. Both kidneys were indistinctly felt; not tender. The area of splenic dulness was considerably increased, extending from the eighth to the eleventh rib, and anteriorly 3 cm. beyond the costal margin. The edge of the spleen was distinctly felt, even with quiet respiration, and on deep inspiration it extended fully 4 cm. below the costal margin. It was unusually broad; its edge was blunt and rounded, and its consistence noticeably firm and tense. Palpation of the spleen caused distinct tenderness.

The patient's temperature, on admission, was 100.4°; respirations, 22; pulse, 88. On February 21 he passed a restless night, with much headache and general discomfort. Early that evening he complained of a sudden, sharp, stabbing pain in the left hypochondrium, soon followed by a severe, aching pain in the left shoulder, radiating somewhat down the left arm. Soon after the onset of the pain he vomited a small quantity of clear fluid, and broke into a profuse perspiration. The pain was so severe as to require an injection of morphine. The respirations were rapid and shallow; there was marked tenderness to pressure just below the costal margin, where the spleen could be distinctly felt, and slight rigidity of the upper part of the left rectus muscle. At times, the pain was felt somewhat in the right hypochondrium.

On February 22 the severe pain in the left side and left shoulder continued throughout the night, in spite of a second injection of morphine. When seen in the morning, the patient looked much more seriously ill. His eyes were sunken, his features drawn and anxious, his respirations shallow and hurried. There was distinct tenderness in the left hypochondrium, and slight muscular rigidity, so that the spleen could not be distinctly felt. The area of splenic dulness, however, seemed larger than on admission. On February 23 the patient passed another restless, uncomfortable night, complaining chiefly of headache and nausea. At times he was slightly delirious. During the day his general condition and appearance improved much, and he was able to take and retain a fair amount of liquid food. The bowels were moved satisfactorily by enema. The pain in the left side had ceased to be troublesome, but there was still slight tenderness in the left upper quadrant. The physical signs in the chest were unchanged, and it was impossible to determine the nature of the violent attack he had had two days before. The occurrence of a pulmonary infarct was suspected, but neither the symptoms nor the physical signs were sufficiently characteristic to justify the diagnosis. The extremities showed no indications of a thrombophlebitis.

On February 24 the patient's general condition was still further improved. He passed a comfortable day and night and seemed to be settling down to a fairly normal typhoid course. Although the Widal test was still negative, blood cultures taken on February 21 showed a Gram-negative bacillus which resembled bacillus typhosus, and which two days later was identified positively as such.

On the morning of February 25, the patient awoke, refreshed after a comfortable night. At 8.30 A.M. he had an attack of coughing, and immediately afterward complained of the same very severe pain in the left hypochondrium and left shoulder. The pain persisted during the morning, and was accompanied by profuse sweating and by the same startling change in the patient's appearance and general condition. His pulse was rapid, small and soft; his respirations hurried, his skin covered with cold sweat and he complained of weakness and nausea. It was evident that something serious had happened, and that his condition was growing progressively and rapidly worse. Examination of the chest showed no change from that of the preceding days. There was dulness on percussion over the greater part of the left side of the abdomen and in the left flank, and some rigidity and tenderness in the left upper quadrant: the rest of the abdomen was soft and flat, and while having a somewhat boggy feel, was not tender. Dr. Downes and Dr. S. W. Lambert were called in consultation, and all agreed that the symptoms indicated a rupture of the spleen. The diagnosis was arrived at by considering the location of the pain, the tenderness and the muscular rigidity; by the absence of signs pointing toward other likely complications, such as intestinal perforation and pulmonary infarct, and, finally, by the fact that the spleen had been recognized as being unusually large and tense for the early days of typhoid fever. With the hope of obtaining some confirmatory evidence of severe hemorrhage, a blood examination was made about three and a half hours after the onset of the pain, and while the symptoms pointed strongly to an alarming loss of blood, the examination gave the following results: red cells 5,280,000; hæmaglobin (Sāhli) 85 per cent.; leucocytes 35,000.

In spite of these apparently inconsistent blood findings, an immediate exploratory operation was decided upon, and at 1.45 P.M., about five hours after the onset of the symptoms, the patient was taken to the operating room. The temperature, which at 8 A.M. had been 102.8°, had fallen to 100°; the respirations were 32; the pulse rate 118. Dr. Downes, under local anæsthesia, opened the abdomen by a vertical incision through the middle of the left rectus muscle. Upon incising the peritoneum, the abdomen was found to contain a large amount of blood. The patient was thereupon given nitrous oxide gas and ether by Dr. Thomas L. Bennett, and the incision was rapidly enlarged to the extent of eight inches. A tremendous quantity of fresh and clotted blood, estimated at from a quart and a half to two quarts, escaped from the abdomen. The left hand was immediately passed to the pedicle of the spleen, which was grasped between the index and middle fingers, and with the right hand the spleen was delivered through the wound. At this point the pedicle was caught with a long, straight rubber-covered clamp, placed close to the spleen. The vessels were then ligated about two inches proximal to the clamp with No. 2 chromicized catgut. The larger blood clots were rapidly removed and the abdomen was closed by layer sutures, without drainage. Time of operation, twenty minutes.

When the hand was first placed behind the spleen lying in its bed, a rent in the capsule, fully three inches in length and running along the posterior border, was encountered. During the manipulation this rent was so enlarged that by the time the organ was delivered from the wound the capsule had been stripped from almost half its surface.

In spite of his critical condition on the operating table, which necessitated an intravenous infusion of salt solution, the patient improved steadily during the succeeding twelve hours. His loss of fluid was replaced by saline solution given by hypodermoclysis and by the Murphy "drip." At 10 P.M. that night the hæmaglobin percentage had fallen to 62, and his leucocytes numbered 68,000. On the following morning (February 26) the pulse had fallen to below 100, and his general condition was very satisfactory. The patient's convalescence was delayed by signs of a pulmonary infarction and a thrombophlebitis of the right arm and calf, but these symptoms gradually subsided, and he was able to leave the hospital on March 31, 1913. A month later he had regained his lost weight and seemed in almost his usual health. At the present time, his health was excellent.

SPLENECTOMY FOR TRAUMATIC RUPTURE OF SPLEEN.

DR. JAMES M. HITZROT presented a boy of fourteen who was admitted to the New York Hospital with the history of having fallen from a truck, striking the edge of the curb on his left side. He felt weak and sick after the fall and complained of severe pain in the left lumbar region. The pain was aggravated on inspiration. He also suffered from thirst.

On admission, the boy was in a state of mild shock. His temperature was 98.6°; pulse 120, regular and of small volume; respirations 48 per minute and gasping in character. The abdomen, which was slightly scaphoid, showed a small contusion over the left tenth rib in the posterior axillary line. The abdomen did not move on respiration, and there was tenderness, especially along the left gutter, with rigidity, but no spasm. In the left loin there was tenderness on deep pressure, with dulness. A blood count gave 18,000 white cells, with 85 per cent. of hæmaglobin.

The case was regarded as one of rupture of the spleen, and the patient was operated on one hour and fifteen minutes after the injury. A six-inch incision was made through the outer border of the left rectus, revealing a bellyful of blood and a lacerated spleen, with its pedicle torn through at the hilum. A clamp was applied and the spleen removed. The tail of the pancreas was elevated, and a spurting artery running parallel to it was clamped. A clamp was also applied to a mass of infiltrated tissue, the lienorenal ligament, just above the artery. There was some oozing in the phrenosplenic ligament which was controlled by gauze. A small accessory spleen was made out, about 1.5. x 1 cm. in size, just mesial to the clamp on the splenic artery. The free blood in the peritoneal cavity was evacuated by suction. The boy was given an intravenous saline infusion, and the wound was closed by tier suture with a small cigarette drain to the site of the oozing in the phrenosplenic ligament.

The patient made an uninterrupted recovery; the drain was removed on the fourth day, and the wound healed *per primam.*

An examination of the patient's blood, made on the day of the operation, showed 4,288,000 red cells; 18,450 leucocytes, with 85 per cent. polynuclears and 15 per cent. mononuclears; hæmaglobin 55 per cent. Two days later the leucocytes had risen to 34,500, with 91 per cent. of polynuclears; the hæmaglobin had fallen to 47 per cent. and the red cells to 3,756,000. There was a gradual decrease in the leucocytosis, with a slow rise in the hæmaglobin, and on September 29, eighteen days after the operation, the red blood cells numbered 3,380,000; the white cells, 17,200, with 75 per cent. of polynuclears and 61 per cent. of hæmaglobin. The latest blood examination, made on October 22, 1913, showed 4,432,000 red cells; 14,400 white cells, with a differential picture of 58 per cent. polymorphonuclears, 33 per cent. small mononuclears, 3 per cent. large mononuclears, 3 per cent. eosinophiles, 2 per cent. cosmophiles, and 1 per cent. transitionals. The hæmaglobin was 76 per cent.

Dr. Hitzrot reported a second case of traumatic rupture of the spleen in a boy, seven years old, who was admitted to the House of Relief, in the service of Dr. Alexander B. Johnson, on August 26, 1913. The history obtained was that he was knocked down by a truck, and it was thought that one of the wheels passed over his abdomen. When he was brought to the hospital, at 12.50 p.m., he was in a condition of marked shock. His temperature was 97° ; pulse, 160; respirations, 32. There were no external signs of violence. The abdomen was somewhat distended and there was marked general tenderness and rigidity with dulness in both flanks—slightly movable. The blood-pressure was 70 mm.

At 4 p.m., four hours after the injury, the abdomen was opened, and a ruptured spleen completely torn loose from the pedicle and lying loose in the splenic fossa was found and removed. During the operation, an infusion of warm saline was given. Salt solution was also introduced by the Murphy "drip," and the patient was surrounded with hot water bottles. About an hour after the operation, the patient's pulse, which had improved considerably under stimulation, again became weak, and he went into a state of profound shock, which ended fatally at 8.20 p.m.

Both these cases are reported to emphasize the greater seriousness of that type of splenic rupture in which the laceration involves the hilum, a fact pointed out by Berger (*Archiv. f. klin. Chir.*, Bd. 68, 1902), who states that this injury is rare and also that the recovery from it is less frequent than in the other type.

Dr. Ellsworth Eliot said that he had never seen a case of spontaneous rupture of the spleen. He had, however, seen a considerable number of cases of traumatic rupture of the spleen, and in speaking of the etiology of this form of injury, there was one predisposing factor which he had met with in two of his cases, namely, a history of malaria, with the formation of adhesions which had bound the spleen to the ribs and rendered it more susceptible to the effects of trauma, through limitations of its movement.

In one of his cases, Dr. Eliot said, the patient was a young girl, who, while riding on a pony, slipped or slid to the grass, giving no indication of direct trauma. Her symptoms led to the diagnosis of rupture of the spleen, and upon laparotomy, a tear of the spleen on its diaphragmatic surface was discovered with considerable blood in the left flank. As hemorrhage had ceased, a tampon was inserted, the spleen remaining *in situ*. The patient made a good recovery. Here the rupture was evidently the result of indirect violence.

Dr. Eliot said that in the recognition of this condition, particularly before hemorrhage has been excessive, he had found dulness in the left flank elicited by auscultatory percussion of great assistance. As to the end results of splenectomy, he had investigated, in 1906, the literature to ascertain if there was any actual lowering of the resistance produced by the loss of the spleen, and had found only a single instance where the short, rapid, and uneven course of a subsequent lobar pneumonia was ascribed to such particular factor. In one of his own cases the patient had a very interesting history, and ultimately died of diffuse suppuration of the liver, in connection with a cholelithiasis of long standing.

As bearing upon the blood findings after splenectomy, the speaker said that in one instance, in the course of the operation, several small accessory spleens were found in the gastrosplenic omentum. Much depended on the presence or absence of these small segments of splenic tissue, which might easily escape detection. The rapid return of some of these patients to an apparently normal condition, as well as the absence of any manifestation of impaired resistance, which are not at all uncommon, might be ascribed to the presence of these bodies.

Dr. Frederic Kammerer said that about eleven years ago he presented a case at a meeting of this Society very similar to that shown by Dr. Downes. In his case, the rupture of the spleen occurred during the third week of typhoid fever. It was evident that the patient was suffering from a hemorrhage, and upon opening the abdomen through a median incision, he found the peritoneal cavity filled with blood. Upon lengthening the incision and removing the blood clots, a much enlarged spleen was found, with a rent about four inches long in its capsule. In the course of the most careful manipulations, this rent suddenly increased to about eight inches, the pulp protruded from the rent and as the hemorrhage was becoming alarming, the spleen was removed. The patient died about twelve hours later. The specimen after operation showed a simple tear in the capsule, which did not extend into the pulp of the spleen. The latter was absolutely intact, and it was evident that hemorrhage had occurred from the separation of the capsule from the pulp. This, at the time of the presentation, was considered very unusual, some authors even denying the possibility of such an occurrence.

Dr. Downes said that Dr. Conner, after a very exhaustive search, had found a record of only twelve similar cases in the literature. In nine of these, the condition was discovered at autopsy; in the three remaining cases, including the one reported by Dr. Kammerer, the rupture of the spleen was found in the course of operation done for supposed intestinal perforation. None of these cases recovered.

Dr. Hitzrot said that in the case he had shown there was an accessory spleen about one and a half cm. long and one cm. wide. This was found near the pedicle.

GANGRENE OF THE CÆCUM SECONDARY TO CARCINOMA OF THE COLON.

Dr. John A. Hartwell presented a salesman, thirty-four years old, who was admitted to the Presbyterian Hospital on May 1, 1913, with the following history:

He was operated on for chronic appendicitis in 1909. Normal convalescence. Since this time up to the beginning of the present trouble he has considered himself in good health, though on careful questioning he states that he has noted some increasing constipation over a recent period. His present illness dates back for one week, and began with acute abdominal pain, distributed pretty generally over the abdomen, with marked constipation, though the bowels have moved after energetic catharsis. Vomiting occurred after two or three days, and the pains got increasingly more severe and gradually became localized to the lower part of the abdomen, more particularly in the right lower quadrant. On admission he presented a typical picture of intestinal obstruction, and the diagnosis of this condition, due to adhesions from a previous operation, was made. Operation was immediately performed, an incision being made in the cæcal region. On opening the peritoneum there was an evacuation of about six quarts of intestinal contents with considerable solid fecal matter. This was mostly confined to the pelvis, but there was some evidence of it extending throughout the peritoneum. The entire anterior wall of the cæcum had sloughed away, making an opening several inches in diameter in which the ileocæcal orifice presented. An adherent band running from toward the midline outward to the ileum seemed to have completely shut off circulation, causing the cæcal gangrene. The abdomen was thoroughly washed out with large quantities of normal salt solution, by means of a suction apparatus, and drains were inserted. He was returned to the ward in fair condition, and immediately began to have copious evacuations through the open cæcum, which had been loosely attached to the skin wound. During the 36 hours following operation he received continuous hypodermoclysis of normal salt solution of which he absorbed 7 litres. This was given following the teaching of Hartwell and Hoguet whose experimental work showed that a serious factor in intestinal obstruction was the dessication of the tissues. His recovery was long and tedious, and in late July an operation was performed for the closure of the fecal fistula, it being planned to make an anastomosis between the ileum and the ascending colon, with the removal of the intervening portion of the large bowel. On opening the abdomen, however, a firm hard tumor was found in the splenic flexure of the colon, causing a complete obstruction. Grossly, this presented all the characteristics of a carcinoma. A number of lymph-nodes in the vicinity were found involved, one of which was removed for examination, and proved to be non-malignant. Lateral anastomosis was made between the ileum and the descending colon below the obstruction, the ileum having been sutured near the cæcum and the two ends closed by inversion. His condition since the operation has steadily improved. He has normal movements per rectum and there is practically no discharge from the cæcal fistula which drains the large bowel as far as the stricture at the sigmoid flexure. The question to be considered is as to the advisability of removing the growth above the anastomosis, and if this is done, what shall be done with the portion of the large bowel between this point and the cæcum?

The interesting points in the case are the fact that a patient could survive the conditions found at the original operation, and the fact that the occlusion of the bowel had gone on to such an extent without symptoms, and the marked benefit that he apparently received from the absorption of such an enormous amount of salt solution in the first hours after his operation.

Dr. George Woolsey, who had seen Dr. Hartwell's patient during the operation, said it then looked like a very unpromising case. As to the future outlook of the case, the speaker said that in view of the fact that in malignant growths of the large intestine it was not uncommon to find enlarged lymph-nodes that did not show carcinoma, the pathological findings in this case could not be regarded as particularly helpful in determining the character of the new growth. The patient was certainly sufficiently advanced in age to allow of the diagnosis of a malignant tumor.

Dr. Woolsey said this case recalled a somewhat similar case that came under his observation some years ago. The patient was suffering from intestinal obstruction, and an opening was made in the cæcum which relieved an enormous dilatation of the cæcum and ascending colon. Subsequently, the obstruction recurred and was relieved by severing a lot of adhesions. Still later, a tumor was found in the splenic flexure which on removal proved to be malignant. That patient was only twenty-two years old.

Dr. Kammerer said that acute obstruction, without any previous symptoms, was not so very rare as cancer of the large intestine. Compensation, by hypertrophy of the intestine proximal to the seat of trouble, often delayed the development of any marked clinical symptoms until the lumen of the gut had been narrowed down to a very small passage. Then the arrest of some intestinal contents at this point might cause complete obstruction, temporary perhaps, but, at all events, the first serious symptom manifested in the case.

Dr. Hartwell, in closing, said this man had absolutely no symptoms of obstruction until the sudden onset of complete obstruction. Several weeks ago he saw a somewhat similar occurrence in a woman, who, with the exception of some cramp-like pains dating back for a number of years, had been comparatively free from symptoms until the day prior to her admission to the hospital, when she was seized with acute vomiting. An exploratory operation revealed a complete obstruction of the bowel by constriction at the splenic flexure. That patient died.

BONE TRANSPLANT SUPPLYING THE UPPER THIRD OF THE HUMERUS.

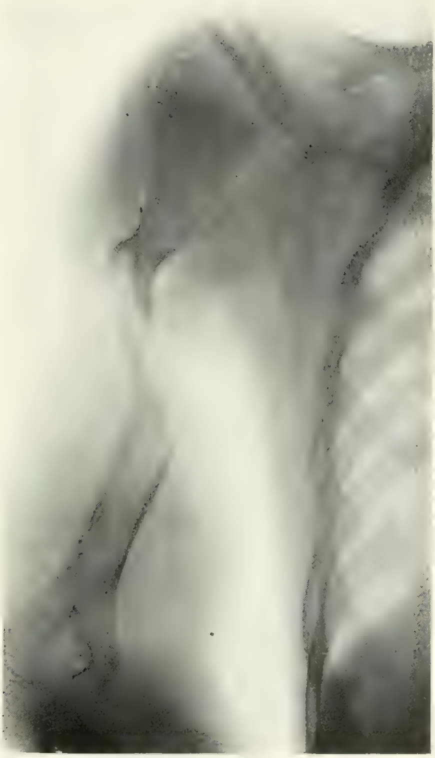
Dr. George D. Stewart presented a school-boy of eleven years who was admitted to St. Vincent's Hospital on June 1, 1912, with the history that on that day he had been knocked down by a horse-car, one of the wheels passing over his right arm and shoulder.

Examination showed a compound, comminuted fracture of the upper end of the right humerus. The axilla was opened so that the finger could be introduced through the wound, and the axillary and brachial arteries were exposed, but the patient had a good radial pulse, could move his fingers, and sensation was unimpaired. The wound, which was much soiled, was irrigated with iodine solution, and packed with gauze to check the bleeding. On the following day he was taken to the operating room, where loose fragments of bone were removed and drains inserted. The radial pulse still continued good. Following this, there was a good deal of sloughing of soft tissues, and on July 6, several fragments of necrosed bone were removed. After a time, the sloughing ceased, and on October 1 the patient was discharged, the wound having completely healed. At this time there was a false point of motion above the middle arm and it was evident that there was an absence of bone in this region: indeed, the tissues here were so contracted that little remained but the artery, nerves and some scarred integument.

In November, 1912, he returned to the hospital, and on the 13th of that month a transplant was taken from his tibia. This section of bone, which was about three inches in length and perhaps half the diameter of his fibula, was then inserted between the ends of the two fragments of the injured humerus. In doing this, it was difficult to find sufficient soft material to completely cover the transplant. The ends of the fragments were very sharp, and it was necessary to cut them off transversely so as to get a point of application for the ends of the transplant. As the arm had shortened considerably by contraction of the soft tissues since the time of the injury, the transplant had to be introduced under strong longitudinal traction, and difficulty was experienced in lengthening the arm because of this contraction. During the necessary dissection, the musculospiral nerve, which was much distorted, was accidentally divided and had to be sutured.

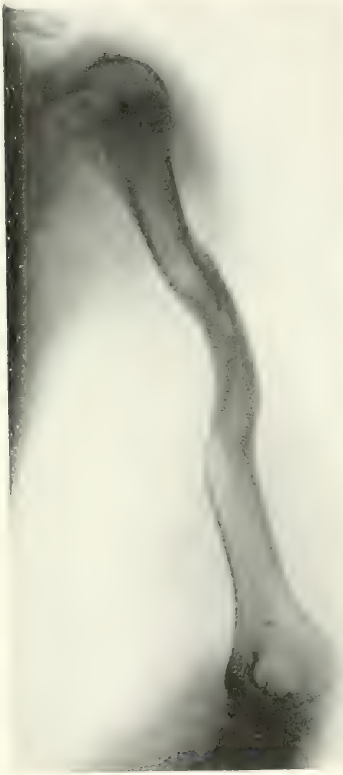
The wound healed by primary union excepting at one point, where there was a slight separation of the cut surfaces, which did not, however, extend to the depth of the transplant. Within a

FIG. 1.



Limb before transplantation.

FIG. 2.



Limb after transplant.

week, the arm seemed to be rigid throughout, and as far as could be made out, there was never any atrophy of the transplanted bone. The paralysis following the operation involved all of the musculospiral distribution. Under massage, this began to improve after a few weeks, and this improvement had steadily continued.

Dr. Stewart said that periosteum was left on the transplant covering two of its four sides. No particular pains were taken to preserve it, and in many parts its edges were raised. Whether it had any influence upon the nutrition of the bone, he doubted. In another case where he utilized a rib to form a bridge in a sunken nose, he relieved the rib entirely of its periosteum, and it seemed to serve equally well. If McEwen's findings were correct, periosteum contained no osteogenetic layer, and served simply as a limiting membrane.

In connection with this case, Dr. Stewart showed a number of X-ray pictures, illustrating the conditions before and after the operation (see Figs. 1 and 2).

This case is presented not only for its interest in connection with the transplantation of bone but also as an illustration of the value of conservative surgery in compound fractures. When it first came under the care of Dr. W. C. Lusk, who was on duty, the conditions were such that amputation seemed almost inevitable, the limb being attached to the body by barely sufficient tissue to carry the vessels and nerves. The result is a very serviceable, almost normal limb.

BONE TRANSPLANT IN A CASE OF RECURRENT FRACTURE OF THE PATELLA.

Dr. John Rogers presented a young woman to illustrate a case of bone grafting in recurrent fracture of the patella. The original fracture in this case occurred on November 1, 1912, and was treated by suture. The following February the patient slipped and re-fractured the patella, and at this time, in addition to the usual treatment of suture, Dr. Rogers chiselled a small bone graft from the front of the tibia, and after lifting the patella periosteum, he inserted the bony graft underneath and sutured it there. The result was excellent. The graft has not become absorbed. A radiograph taken in October, or nine months after insertion of the graft, shows it still in place and unchanged in size. Its under surface has blended with the anterior surface of the patella, and the former line of fracture is filled with bone. This method of treatment was employed by Dr. Rogers to repair a non-union of the patella in another case, with excellent results.

THE FUNCTION OF THE PERIOSTEUM IN BONE TRANSPLANTS: BASED ON FOUR HUMAN TRANSPLANTATIONS WITHOUT PERIOSTEUM AND TWENTY-EIGHT ANIMAL EXPERIMENTS. ILLUSTRATED WITH LANTERN SLIDES.

Dr. Clarence A. McWilliams read a paper with the above title, for which see page 465.

Dr. James M. Hitzrot said Dr. McWilliams' paper was particularly interesting to him inasmuch as his interest was directed toward the function of the component parts of the bone in the process of repair after fractures. In this repair process new bone appears from the periosteum and from the endosteum on both sides of the fractured cortex, most marked on the concave side of the fracture. The cortical bone does not participate in this process until after the new bone has undergone a fairly marked degree of consolidation and there is no evidence of bone cell proliferation from the cells of the cortex. In fact, the space between the fractured ends seems to become filled by cells arising from the endosteum and to a lesser extent from the periosteum, while the cortex is undergoing absorptions. Cotton and Loder (*Surg., Gyn. and Obstetrics*, June, 1913) consider the endosteum as the important factor in the formation of bone in the transplant. My experience with cortical bone without periosteum has been similar to that of Dr. McWilliams, that is, failure in four cases with absorption of the graft.

In one of my grafts a fracture due to a fall occurred but the outcome was not as satisfactory as that case shown by Dr. McWilliams, inasmuch as the graft became absorbed and union did not occur, although the X-ray picture had shown new bone along the surface of the graft before this accident.

Dr. Fisk said that at a recent meeting of the alumni of the Massachusetts General Hospital in Boston, Dr. David F. Jones had shown a case where he had resected the entire lower jaw. Afterward this patient was referred to the Harvard Dental School, where an ingenious apparatus was devised to replace the lower jaw bone.

This consisted of a bridge which was fastened to the molar teeth on the upper jaw, at each end of the bridge there was a ball-and-socket joint. And from the lower surface of each ball there extended downward a pivot, which fitted into a socket in the ascending ramus of an artificial lower jaw bone, made of gold, on which were teeth. This gave a shapely contour to the lower portion of the face; an open and shut action of the mouth, with, also, a slight grinding or lateral motion.

THE FORMATION OF A NEW THUMB BY KLAPP'S METHOD.

Dr. H. H. M. Lyle showed X-ray plates and photographs of a case where a new thumb had been formed from the metacarpus. This patient's left hand was run over by a trolley car. The thumb, index and middle fingers were evulsed at the metacarpophalangeal joints, the ring-finger at the base of the first phalanx. There was a fracture of the metacarpus of the thumb, the dorsal skin was destroyed up to the level of the wrist, the tendons of the above fingers were torn off.

Operation at St. Luke's Hospital. The stump of the hand was trimmed, the torn tendons brought down and sutured over the ends of the bones, the fracture of the first metacarpus corrected, the whole enclosed in a saturated dressing of Balsam of Peru.

The wound remaining clean, the hand was inserted under an abdominal pocket flap. The flap took nicely and provided a good covering for the dorsal aspect of the hand and wrist. A curved dorsal incision dividing the soft parts between the first and second metacarpals was made; the first metacarpus mobilized by separating the attachment of the dorsal interosseous. In this way it was possible to approximate the metacarpus of the thumb and little finger. Care was taken to avoid injuring the thenar muscles. The skin of the dorsum was carried around the metacarpus of the index finger and united to the palmar skin, the carpus of the thumb being treated in a similar way.

The most important finger in the hand is the thumb and its loss is a serious misfortune. Klapp's method, by producing a short but useful thumb, provides an amelioration of this distressing condition, and marks a distinct advance in the traumatic surgery of the hand.

Stated Meeting, held at the New York Academy of Medicine, January 14, 1914.

The President, DR. FREDERIC KAMMERER, in the Chair.

SUBCLAVICULAR DISLOCATION OF THE HUMERUS.

DR. ROBERT H. M. DAWBARN presented an elderly man, who, seven months before entrance to the City Hospital, had fallen, causing a typical subclavicular dislocation of his left humerus. Repeated attempts at reduction under anæsthesia had been made before his admission. The elbow stood away from the side at an angle of about thirty degrees, and all motion of the arm was very painful.

Under major anæsthesia, one month ago, another attempt at reduction was made. This failing, the head of the humerus was excised through a vertical incision close to the anterior edge of the deltoid. It was placed thus far forward for two reasons: to save the more readily the long tendon of the biceps, and to destroy as little as possible of the value of the circumflex nerve, which inevitably had to be divided.

No attempt was made to do what seemed simple, but was really quite the reverse, namely, to free the bone from its false position, clear out all tissue from the glenoid cavity and replace the humerus. This, Dr. Dawbarn said, he would never personally attempt, at least in a case of long standing, such as this. Twice he had had the opportunity to assist excellent surgeons and dissectors at such an attempt, the first time under the late Dr. Charles McBurney, who, notwithstanding his deftness with the knife, cut the musculospiral nerve by accident. The second time was with Dr. John A. Wyeth, and after more than two hours' work it was accomplished, but the patient died from shock.

In the present case, the speaker said, he chiselled through just below the head, which was then removed in several large bites by the rongeur forceps. The work took but about twenty minutes altogether. As was now evident, after the healing, which was *per primam,* the man had a comfortable, freely movable false joint, with so little shortening of the limb as hardly to be noticeable. He was receiving daily treatment with electricity and massage, and strychnine by needle, chiefly into the deltoid muscle.

BONY ANKYLOSIS OF THE ELBOW: FRACTURE OF THE LOWER EXTREMITY OF THE RADIUS.

Dr. Dawbarn presented a woman of forty, who six months before her admission to the hospital had fallen, badly breaking her right elbow and producing a fracture of the lower extremity of the radius on the same side. She had sustained a similar injury of the left wrist some years earlier. Both fractures were typical of improper treatment, the wrists being badly deformed, and her right elbow was entirely ankylosed. She permitted operation, one month ago, upon the right limb, because, as she said, she had to work, but no persuasion could induce her to allow her left wrist to be corrected at the same time.

Both operations were a success. The elbow incision was a six-inch vertical Langenbeck one, the olecranon being its midpoint. The triceps insertion was split and removed by " egg-shell " work with chisel and mallet, leaving its continuation into the deep fascia of the forearm intact. The entire trochlear surface of the humerus had to be chiselled away, and then one of the half insertions of the triceps was freed below and so fastened as to prevent bony ankylosis. Passive and active motion were both refrained from until three weeks had gone by—the usual period of exudate of callus: this to lessen the exudate of provisional callus and hence new bone in the joint, in excess.

At the wrist, the operation performed was that which was described in Binnie's Operative Surgery, and elsewhere, and credited to Dr. Dawbarn. In the latter's opinion, it was frequently needed. He had done it now over twenty times with success, and had read a paper upon it and showed patients a good many years ago at a meeting of the Fifth District Medical Society of New York State in Newburgh.

The technic of the operation for the correction of the wrist deformity was as follows: A vertical incision was made at the seat of the radial fracture. The soft tissues were dissected off the bone, back and front, gauze being packed in as a protection during the next step, namely chiselling. By this means, transversely, the bone was divided entirely, and then, by leverage, the lower fragment of an inch or so was pried distally until its styloid process was, as was normally the case, about two-thirds of an inch nearer the digits than that of the ulna. Next, the matted and often useless tendons, from old tenosynovitis—those normally grooving the back of the radius here—were dissected free from other tissues to play hereafter in loose connective tissue beneath the skin. As much of each sheath as was practicable was removed. To the surgeon, the sheath was simply a nuisance, inviting adhesions again if left.

Next, at about the middle of the shaft of the ulna, a piece of this bone of about one-half inch in length was removed by use of the Gigli saw twice. This had a two-fold purpose: (*a*) it enabled the gap thus created to close by subsidence of the subluxated lower end of this bone, a deformity always very noticeable. Such subsidence took place spontaneously, thus encouraged, in the course of a few days. (*b*) The piece of the ulnar shaft thus removed was now comminuted by chisel into a number of small bits, which were tucked into the chisel-gap in the radius, thereby filling it by a bone-plastic job, preventing the chisel-gap closing together, with return of the deformity. Next, the skin was closed as usual.

In the present case the result was seen to be perfect, and, in striking contrast with the deformity of the left wrist, still uncorrected.

Dr. L. W. Hotchkiss asked if it was necessary, for the correction of this type of deformity, to divide the ulna. Did not this step and the introduction of the fragments of bone into the gap of the radius needlessly complicate the operation? Personally, he had corrected many of these deformities by simply chiselling through the radius, and he did not think that a more extensive operation was usually indicated.

Dr. Dawbarn replied it was because of the unsatisfactory results of the old method—for simply chiselling the radius was old indeed—that he came to try the present plan. He objected to its being considered as adding a complication and taking time needlessly. Certainly it was worth while to overcome the ulnar deformity almost or quite as much so as the radial, and this could only be done by removing a piece of it, and once removed, it did not add over a minute or so to the work to comminute the ulnar piece and make use of it in the radial gap, thus assuring maintenance of the styloid process at the level desired.

Dr. John F. Erdmann asked why Dr. Dawbarn comminuted the ulnar fragment. Why not place it in the radial gap just as it came from the ulna?

Dr. Dawbarn said that in the first place, its shape would preclude its fitting the gap in the radius, if this were tried. Again, the more finely a bone was subdivided, the greater became the prospects for success in re-planting it, for its blood-vessels no longer carrying nourishment to its interior, it depended for life upon the vitalized plasma bathing it; and the more the comminution, the shorter the distance that nutriment had to be carried to the interior of the bone by capillarity—the only remaining possible way. Sir William MacCormack taught us that in many cases trephine discs, if replaced and possessing a fair amount of diploë, would live, but experience proved that if the trephine disc be first well chiselled or bitten into small pieces, and then replaced upon the dura mater, its chances of surviving were greatly increased.

MODIFICATION OF SYME'S AMPUTATION.

Dr. Dawbarn presented an Italian lad of nine years who three months ago was run over by a truck, partly crushing his left foot, in consequence of which the entire foot died, including the heel. This made a typical Syme's amputation impossible; and indeed, the present case differed from the regular Syme's, although performed at the usual level, in three ways, and Dr. Dawbarn said he considered the case to represent a real advance in technic and in end-bearing comfort. Point number one was that the entire flap had to be made from the comparatively thin skin upon the anterior surface. Point number two was the fact that the main nerves, all capable of pain, were carefully shortened, so as no longer to be walked upon and nipped between the stump end and the artificial limb, a thing often occurring otherwise. The posterior tibial nerve and its plantar continuation were dissected from the accompanying vessels and divided at a point some two to three inches above the stump-end. The same was done with the external saphenous nerve, and (in this case) with the internal saphenous nerve. Point number three had to do with the fact that a typical

Syme's amputation was a curious mixture of a good and bad principle, if we accepted, as he thought all surgeons now did, Bier's postulate that no matter how much muscle, fat and fascia covered and padded a stump-end, it could never be a thoroughly first-class " end-bearing stump " unless its bony end was covered by (*a*) either normal articular cartilage, or (*b*) periosteum. As a typical instance of the former we had a Stephen Smith amputation at the knee, and as an equally good example of the latter we had a Gritti amputation, osteoplastic, at or rather a little above that level, the patient walking upon the periosteum covering the anterior surface of his patella.

Now, as to the Syme's technic, the central two-fourths or thereabouts would be the cartilage of the lower end of the tibia, and consequently, method *a* of Bier. But on either side was a sawn malleolar surface, making the remaining two-fourths a flat violation of Bier's *b* method.

In the present case, and in a considerable number of previous cases Dr. Dawbarn cited, Bier's method *b* was adhered to in principle by a simple means, namely, gnawing out by rongeur forceps the cancellous interior of each malleolus, starting from the median line of the leg and working out or in, according to the malleolus under treatment, until in a very few minutes nothing but an egg-shell-like lining of the periosteum remained. The periosteum, under the application of the usual dressings, collapsed into a firm support upon either side at the same level with the central or cartilaginous two-fourths.

Although the healing was but recent in this case, about a month since the operation, the stump face was free from all tenderness; it was firm, and jarring from below, as was demonstrated, did not cause the patient any discomfort.

In conclusion, Dr. Dawbarn expressed surprise at the ignoring of the great importance of shortening all pain-bearing nerves in major amputations, so noticeable in the reports of all surgeons. Probably no improvement in amputation technic could be more important than this. For example, if he had occasion to amputate through the leg, he shortened all the five pain-bearing nerves, and this great benefit added but a few minutes to the length of the operation.

RESECTION OF THE HIP FOR TUBERCULOSIS.

Dr. Walton Martin presented a boy, twenty-one years old, who was admitted to the Roosevelt Hospital on February 5, 1909, complaining of pain and disability in the right hip. He stated that two years before that time he had first noticed pain in the right hip, and had commenced to limp. The pain gradually increased in severity so that it kept him awake at night. About a year later he was obliged to resort to crutches, and a plaster case was applied to the body and thigh, which he had worn constantly since. Otherwise he had always been well.

Physical examination at the time of the boy's admission showed marked limitation of motion, due to muscular spasm, with tenderness over the hip-joint and atrophy of the neighboring muscles. The circumference of the right thigh, four inches above the patella, was twelve inches; that of the left thigh at the same point was fourteen and a quarter inches.

On February 8, 1909, under ether anæsthesia, the hip-joint was resected. The angular incision advocated by Kocher, passing upward and backward in the direction of the fibres of the gluteus maximus and downward along the trochanter major, was made through the skin, and the fibres of the gluteus maximus and its broad fascia of insertion were divided and retracted downward. The inferior border of the gluteus medius was exposed, and the tendon of the pyriformis identified. The tendons of these muscles were separated from their insertion into the trochanter, and retracted upward. The obturator internus and the gemelli and obturator externus were divided close to their insertion. The joint was opened, the ligamentum teres divided and the head disarticulated. A Gigli saw was passed about the neck, and the head and neck removed. The thickened synovia was dissected out, and the acetabulum carefully curetted. Iodoform powder was dusted over the surface of the acetabulum and the adjacent denuded areas, the divided muscles were approximated with catgut and a gauze drain inserted to the bottom of the acetabulum. The skin was closed by silkworm gut sutures and a plaster-of-Paris spica bandage applied. No attempt was made to fix the end of the femur in the acetabulum.

Pathological findings: The specimen consisted of the head and neck of the femur and the synovial membrane. The articular cartilage of the head was badly eroded and detached. Microscopical examination showed synovial tuberculosis and tuberculous erosion of the bone near the surface. The articular cartilage appeared as small fragments imbedded in fibrous tissue.

Two days after the operation the patient showed marked symptoms of iodoform poisoning. At times he was delirious, alternating with stupor. The pulse ranged between 130 and 160; the temperature from 101° to 103°. The urine showed a marked iodine reaction. These symptoms gradually subsided, the wound healed satisfactorily and the drainage tract closed. His weight at this time was 112 pounds.

After several months the patient noticed pain and swelling in the right wrist, and examination showed a localized, fluctuating swelling over the ulnar portion of the right carpal joint. This was treated for several months by the Bier hyperæmic method, and he was then instructed how to continue the treatment himself.

On September 10, 1910, about nine months after the resection of the hip, he had a pulmonary hemorrhage, and examination showed considerable involvement of both apices. He was sent to Dr. Trudeau's sanitarium in the Adirondacks, where he remained until last autumn, when his condition was so much improved that he was permitted to return to New York. He now weighed 143 pounds; he walked easily, without pain and without the aid of a stick. His wrist showed no signs of disease.

This case, Dr. Martin said, seemed to him to be of special interest for several reasons: 1. Recovery after a considerable tubercular infection, with multiple foci in the lungs, wrist and hip. 2. The fact that the patient developed iodoform poisoning, although the amount used was not excessive—less than a drachm. 3. The very excellent movable joint which had been developed, and the appearance of the X-ray showing the margin of the neck resting against the acetabulum, suggesting the formation of a new neck.

Dr. Dawbarn said that iodoform poisoning might probably be held identical in symptoms with poisoning by iodine itself, since iodoform was nearly 97 per cent. iodine. As to the latter, now so freely used by surgeons in the form of the official tincture upon wound surfaces, it would seem that this could not be free from risk as one factor in the rapid, feeble pulse of shock, especially if some idiosyncrasy should exist. The speaker said he could not forget a case where Dr. Wyeth, many years ago, had been frank enough to report having caused the death of a patient from acute iodism. It was in the days when the usual treatment for hydrocele, after tapping and emptying, was to inject and leave in the tunica vaginalis sac tincture of iodine. This Dr. Wyeth did, not using at all an unusual amount. But if this case thus died, was it not advisable to select, especially where there seemed any risk of shock, as in long operations, weak hearts or little children, a means of flushing out the wound for antisepsis more free from risk? The speaker said he thought so, and had for some time past not used the tincture of iodine in these instances, but instead, Burrow's solution of aluminum acetate.

THYMECTOMY FOR TRACHEAL OBSTRUCTION.

Dr. William A. Downes presented an infant, four months old, with the following history: Five weeks after birth, which had occurred at full term and after a normal delivery, the parents noticed that the child coughed occasionally and had some difficulty in breathing. The condition was at first regarded as a cold, and the attending physician made a diagnosis of bronchitis. There was no fever. The dyspnœa was more or less continuous, with occasional exacerbations, especially at night. The breathing was noisy, and, as the mother described it, " whistling " in character. The dyspnœa gradually became more marked, and the child was admitted to the Jewish Hospital in Brooklyn, where he had many attacks of stertorous and whistling respiration but was never cyanosed. The child's digestion was good, and it had gradually been gaining in weight, although the mother stated that during the early part of the illness there had been occasional attacks of vomiting after nursing. The family history was unimportant.

When the child was brought to the Babies' Hospital, on November 15, 1913, it was nine weeks old, and the history dated back about one month. At this time there was continuous dyspnœa, with inspiratory stridor, expiration being free. In crying, the voice was clear, and there was no real hoarseness, and when the child was quiet there was a stridulous whistling sound on inspiration. He had a distinct funnel-shaped chest, and upon inspiration there was a marked depression at the suprasternal notch, and the lower part of the sternum. Percussion revealed dulness over the upper part of the sternum, extending on either side over an area 7 cm. wide, and slightly farther to the right side than to the left. This dulness extended as low as the fourth rib on the right side and on the left side merged with the cardiac dulness. Otherwise, the physical examination was negative.

During the child's first week in the Babies' Hospital there were many attacks of partial suffocation, and one of these nearly proved fatal. There was, however, no cyanosis. A few whiffs of ethyl chloride appeared to afford considerable relief, and the inhalation of steam seemed to be the most satisfactory treatment.

Operation, November 21 : Ether anæsthesia. A two-and-a-half-inch vertical incision was made in the midline of the neck, extending well down over the sternum. The inner border of the sternomastoids was exposed, and the fascia covering the deeper muscles was incised in the middle line. The sternothyroid muscles were then separated and retracted, and in the lower angle of the wound the upper pole of the thymus could readily be seen rising and falling with each respiration. The gland was covered by its thin, transparent capsule, which was caught between tissue forceps and incised. The upper extremity of the right lobe of the thymus was then grasped with forceps, and by gentle traction and wiping the capsule with gauze, this half was removed completely. No vessels were ligated. The left lobe did not come out with the right, as is frequently the case, so a similar procedure was adopted for its removal, with the result, however, that the lobe broke in two, the lower portion, less than one-half, retracting well under the sternum. At this time the trachea came well into view, as did also the left innominate vein, and as there appeared to be no pressure upon the trachea, no further effort was made to remove the remaining portion of the gland. The wound was closed with interrupted layer sutures.

Following the operation, there was little change noted in the respiration for three days, with the exception of the fact that there were no further severe paroxysmal attacks, with suffocation, such as were present prior to the operation. After the third day, however, the breathing gradually improved, and when the child was quiet, breathing was practically noiseless. A slight attack of bronchopneumonia occurred during the child's convalescence. On the fifth day, there was a rise of temperature and a discharge was noticed from the wound. From that time until the wound closed the child was kept in the prone position with the head low, in this way hoping to avoid extension of the infection to the mediastinum. That this proved successful was shown by the fact that the temperature soon fell to normal, and there was no further trouble. The leucocytosis reached 36,000 at the height of the infection, gradually falling to 25,000 and it has since remained about 20,000. This was perhaps accounted for by a slight purulent discharge from one of the child's ears.

Weight of the thymus removed, 7.05 grammes, and the report of the pathologist was, normal thymus gland.

At the present time, eight weeks after the operation, the child seems normal in every way. He breathes freely without effort, and is gaining rapidly in weight and is apparently well.

In connection with this case, Dr. Downes called the attention of the Society to the excellent article on Surgery of the Thymus Gland, by Dr. Charles A. Parker, of Chicago, in the *American Journal of Diseases of Children,* February, 1913.

TORSION OF THE OMENTUM.

Dr. Ellsworth Eliot presented a man, fifty-seven years old, who was admitted to the Presbyterian Hospital on November 4, 1913, with the history that nine days before he had a sudden attack of pain in the lower right quadrant of the abdomen. The pain was sharp in character, increased by respiration and by movement of the abdomen, and alleviated by rest in bed. After persisting for several days, the pain disappeared for two days, only to recur in the same location. It was not present at the time of the patient's admission to the hospital. There had been at no time any nausea, vomiting, chills, fever nor jaundice. The bowels had been constipated for some time. The patient was said to have had a similar attack nineteen years ago, lasting six weeks. With that exception, he had always been well.

Examination of the abdomen showed a large, smooth, slightly tender mass in the lower right quadrant, and extending for several inches across the median line into the left side. It extended slightly above the level of the navel and could be distinctly felt by rectal examination. It had no respiratory movement, and was flat on percussion. It was elastic in consistency and was regarded as a large abscess connected with the appendix. The blood count, however, showed a general leucocytosis of only 8375, with 75 per cent. of polymorphonuclears. The pulse ranged between 80 and 100, and the temperature was normal.

Operation: Through an intermuscular incision on the right side the peritoneal cavity was opened, and was found to contain a considerable amount of old, partially clotted blood. The mass was found to consist of dark-colored omentum extending across the middle line. The appendix was small, atrophic and slightly reddened, but not distinctly inflamed. It was removed in the usual way. The abdomen was then opened in the midline, below the umbilicus, and the mass of gangrenous omentum—for such it proved to be—was delivered in a twisted condition and amputated. At one point it was firmly adherent to the right, anterior abdominal wall, just to the outer side of the urinary bladder.

After the removal of the omentum, the pelvis was found to be filled with small intestine, very firmly adherent to each other and to the lateral pelvic wall. These adhesions were separated by careful dissection. The transverse colon, to which point the omentum had become gangrenous, was somewhat convoluted and distended, but not obstructed. The abdominal incisions were closed, a drain being inserted into the pelvis.

The patient was somewhat uncomfortable for several days after the operation, being troubled with distention. This yielded to colonic irrigation, and thereafter he progressed satisfactorily until the nineteenth day, when a swelling appeared in the right inguinal canal. This was opened, and several ounces of pus evacuated, from which a culture of staphylococcus was obtained. This abscess must have been the result of a continued necrosis of the stump of the omentum attached so firmly to this part of the anterior abdominal wall. The discharge from the drainage opening was largely serous, with a small admixture of pus, which disappeared about ten days after the operation.

Examination of the omental mass by Dr. Clarge showed a condition of extensive thrombotic necrosis.

Dr. Frank S. Mathews said he recently met with torsion of the omentum in a woman with symptoms simulating those of appendicitis. A tumor could be made out. Upon opening the abdomen he found a mass of adherent omentum which had partially rotated from right to left, but was not completely gangrenous. There were no evidences of any attachment outside of the recent adhesions. The appendix was not involved.

Dr. Eliot said that one of the unusual features of his case was the absence of constitutional symptoms in the face of such a grave condition. The patient was able to be up and about for two days after Dr. Eliot first saw him.

ABSCESS OF THE KIDNEY.

Dr. Eliot presented a man, thirty-two years old, who was admitted to the Presbyterian Hospital on October 6, 1913, with the history that since the preceding July he had suffered from a dull pain in the left lumbar region, with loss of appetite, weakness, rapid loss of flesh and constipation. In September he improved for a time, only to have a recurrence of his former symptoms, together with hæmaturia. During these attacks, the patient suffered from a high temperature and was confined to bed. There was no history of frequent micturition. The patient said he had had frequent attacks of gonorrhœa, and he believed that there had been a mass in the left lumbar region for the past three or four years.

Upon admission, the patient looked very ill, with marked anæmia and clammy perspiration. There was a smooth mass in the left lumbar region extending downward to the crest of the ileum. This was tender and did not move with respiration. The tenderness was still further increased by pressure on the lower ribs, and there was rigidity of the lower part of the left costal arch. The temperature was 104°; pulse, 130. A blood count showed a general leucocytosis of 14,000, with 81 per cent. of polymorphonuclears.

Operation: The perinephric space, exposed through a lumbar incision, was œdematous, but contained no pus. The kidney was much increased in size, of a grayish color, and was partially separated from its bed of connective tissue, to which it was moderately adherent. A cavity near its centre was first located by the needle and then opened, evacuating a considerable amount of grumous material, together with a small quantity of pus, which, upon culture, showed streptococci. This cavity was packed with gauze, the perinephric space was drained and the wound partially closed. The temperature gradually fell, reaching normal on the thirty-eighth day, and from that time on, with the exception of two sharp exacerbations of temperature, the patient's convalescence was uninterrupted. A urinary fistula persisted for about three weeks. Directly after the operation, the urine contained a large amount of pus. This gradually diminished as the wound assumed a healthier appearance, and it had practically disappeared when the patient left the hospital.

After convalescence was established, an attempt was made by

Dr. A. T. Osgood to catheterize the ureter; this failed, owing to a stricture in the membranous part of the urethra. It was not improbable, Dr. Eliot thought, that the infection of the kidney was due to an ascending pyelitis from this source.

DELAYED UNION OF THE FEMUR (SPECIFIC).

Dr. Eliot presented a man, twenty-five years old, whose family history was negative, and who gave no history of lues, either inherited or acquired. When a boy, he fractured his left tibia; healing was rapid, but was followed by a persistent, tender, localized swelling. In 1907, a portion of one rib was excised for an acute inflammation. This operation was followed by a sinus.

Present history: In February, 1911, while putting on his shoe, he felt something snap in his right thigh. He was able to walk downstairs, but while returning upstairs his leg gave way under him, the femur fracturing in its lower third. The thigh was put up in a Buck's extension for three months, and then for ten weeks in a plaster case, with absolute non-union.

The patient was admitted to the Presbyterian Hospital on October 10, 1911, where examination showed a fracture of the lower part of the shaft of the femur, with free mobility of the fragments, which were held together by soft tissues. A radiograph showed no callus nor bony deposit. The ends of the bone were in close apposition. A Noguchi Wassermann test was positive.

Up to January, 1912, the patient was given half-grain doses of mercury salicylate intramuscularly every four days, with potassium iodide, up to 180 grains, by mouth, daily. The thigh was fixed in a side splint, and was daily baked and massaged. During this period he also received fourteen injections of 10 c.c. each of his own blood at the site of the fracture.

The result of this treatment was practically negative. The thigh was no more rigid than on admission, and the radiograph showed little change in the bone, although his Wassermann was now negative. During the first six months of 1912 he received five intravenous injections of six-tenths of a gramme of salvarsan, and wore a plaster spica. He was then fitted with a walking hip splint and was discharged from the hospital with the thigh considerably firmer, but with slight change in the radiographic picture. He was given occasional doses of salvarsan until March, 1913, when, with the use of an antigen from the heart of a guinea pig, his Wassermann showed a 3-plus reaction. In the meantime, however, the thigh became rigid, although no severe strain had been put upon it.

Beginning in September, 1913, very active antisyphilitic treatment was instituted. Mercury was given simultaneously by hypodermic and by mouth, with injections of salvarsan every four to seven days. Under this treatment, the hiatus between the fragments observed by the radiograph gradually disappeared, and was replaced by fairly dense bony tissue. The patient's Wassermann, in the meantime, remained 3 plus.

GALL-STONES IN THE YOUNG.

Dr. Frank S. Mathews presented a girl, sixteen years old, who came under his observation about three months ago with the history of an acute attack of gall-stone colic dating back one week. There was swelling and tenderness over the region of the gall-bladder, which upon operation was found to contain a calculus impacted in the cystic duct and pathologically showed a pure culture of typhoid bacillus. According to this girl's history, she had never had typhoid fever nor other illness.

Dr. Mathews also reported a second case of gall-stones in a patient 21 years old, and said he thought that at least one-half of the cases upon which he had been called upon to operate for gall-stones were under the age of 30. One was a woman of 24; another was a woman of 26 whose history dated back for a considerable time.

Dr. Downes showed sixteen gall-stones which he removed last September from a girl thirteen years of age. The case was of acute onset, in fact, it had been regarded as one of acute appendicitis, and it was not until the patient was under the influence of the anæsthetic that the trouble was located in the gall-bladder.

Dr. John F. Erdmann said that fully fifteen years ago he reported a case of gall-stones in the common duct of a young girl aged seventeen, whose history dated back about three years, making her but fourteen years old at the time of onset. Stones were found in the common bile duct and gall-bladder.

Dr. Martin said he did not think that gall-stones were very uncommon in subjects under the age of 30. Last year he had operated on two such cases, one 22, the other 24 years old, with multiple stones in the gall-bladder.

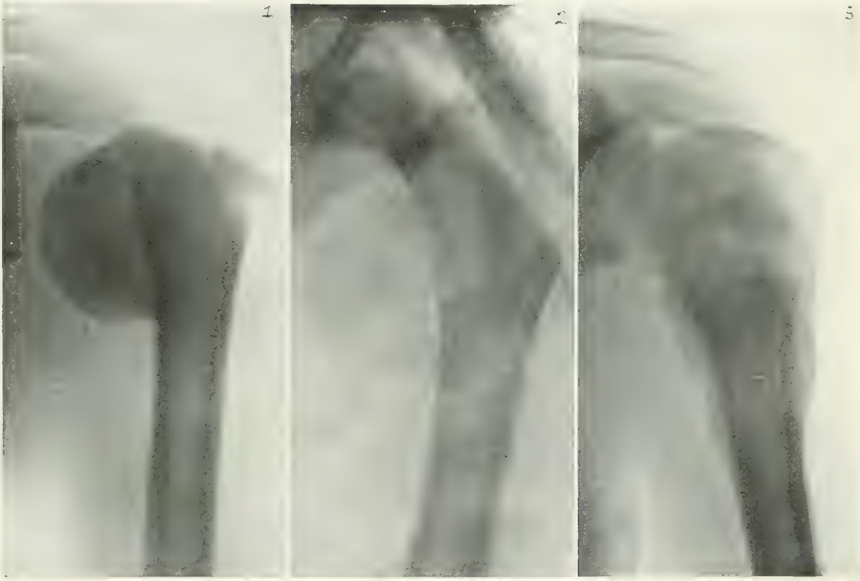
FRACTURE OF THE SURGICAL NECK OF THE HUMERUS.

Dr. Burton J. Lee presented a boy, fifteen years old, who was admitted to the hospital on September 17, 1913, with the history that three days before he had fallen a distance of about three feet, striking on his right shoulder and the outer side of the arm (see Fig. 1), followed by pain and loss of function in the affected arm. He came to the dispensary, where a diagnosis of fracture of the surgical neck of the right humerus was made. At that time the shoulder was swollen, and when the shaft of the radius was rotated, the head rotated with it. External to the head was an irregular prominence which was interpreted as the lower fragment displaced outward and upward and held impacted. No crepitus was obtained. Motion was limited in all directions and there was about 2.5 cm. shortening.

On September 17, under ether anæsthesia, an attempt at reduction was made by Dr. Lee. Traction was exerted downward on the arm while the head of the humerus and the shoulder were held fixed. The arm was then abducted. Before doing this it was necessary to break up adhesions and impactions between the fragments. Only a partial reduction was accomplished. The arm was abducted to a right angle with the body, and the forearm flexed on the arm at a right angle. In this position, a plaster-of-Paris spica was applied (see Fig. 2). The X-ray showed poor position.

Five days later a second attempt at reduction was made under ether. The shoulder was fixed and traction exerted downward on the lower fragment, then the arm was abducted and rotated externally. A plaster-of-Paris spica was applied with the arm abducted to a right angle with the body, and the elbow flexed at a right angle. This attempt at reduction was also unsuccessful, and on September 26 an incision 8 cm. long was made over the outer aspect of the humerus, exposing both the upper and lower fragments. A portion of the upper fragment was found to be loose, and was removed. The long head of the biceps was found to be bound around the head of the humerus, preventing proper reduction. This was pried loose and returned to its place. The upper fragment was but slightly movable, due to adhesions, and there was considerable over-riding of the upper fragment by the lower one. To overcome this, about 2 cm. of bone was

Fig. 1. Fig. 2. Fig. 3.



Fracture of the surgical neck of the humerus.

removed from the end of the lower fragment, which was then brought into apposition with the upper one and held by a chromic suture passed through the periosteum of the two fragments. The muscles were then sutured with interrupted plain gut, and the skin was closed with a continuous silk suture. A rubber tissue skin drain was inserted, and a dry dressing applied. The arm was held in abduction and flexed to a right angle at the elbow by moulded plaster splints. This dressing was left in place three weeks. (See X-ray Fig. 3, taken some weeks later.)

At the present time, January 14, 1914, the patient can abduct the right arm almost to a vertical line, the limitation, as compared with the normal side, being very slight. All other motions are free and apparently normal.

This case, Dr. Lee said, illustrated the difficulty of reduction of fractures of this type without an open operation, and furthermore, it was an example of a case treated successfully without a foreign body splicing the fragments.

A CONSIDERATION OF CERTAIN COEXISTING LESIONS OF THE GALL-BLADDER AND KIDNEY.

Dr. Ellsworth Eliot read a paper with the above title, for which see page 679.

Dr. Eliot also showed a patient, illustrating the subject of this paper.

Dr. Erdmann said he had recently operated on a man who came to him with the suspicion of having malignant disease of the œsophagus. His chief complaint was pain in the left shoulder. An X-ray was taken, which failed to show any lesion of the œsophagus, but revealed two calculi in the left kidney, and with the removal of these, the man was entirely relieved of his symptoms.

Dr. Erdmann recalled another case where he had operated for gall-bladder disease in a patient who had previously been operated by the late Dr. Edebohls for a renal calculus on the same side.

Stated Meeting, held at the New York Academy of Medicine, January 28, 1914.

The President, Dr. Frederic Kammerer, in the Chair.

SUPPURATIVE OSTEOMYELITIS OF THE TIBIA.

Dr. James I. Russell presented a girl, four years old, who was admitted to the Roosevelt Hospital on July 18, 1911, with a discharging wound over the left internal malleolus of the left tibia. The child's history dated back three years. When fifteen months old she developed a small abscess behind the left ear. Shortly afterward she began to complain of pain in the right leg, with swelling, redness and tenderness. An abscess developed, which was incised on two different occasions. Later, the left leg began to swell, and an abscess formed over the tibia; this ruptured spontaneously. When admitted to the hospital there was visible a small sinus just behind the internal malleolus of the left tibia which led to roughened bone, and the adjacent bone was thickened and tender.

Operation, July 22, 1911, by Dr. Russell, consisted in the removal of the whole shaft of the tibia with the exception of a small portion of each diaphyseal end, which was not involved in the suppurative process. An incision was made over the anterior surface of the tibia, splitting the periosteum, which was thickened, and which separated easily from the shaft. It was separated throughout its entire extent and the shaft removed by means of a Gigli saw. The periosteum was sutured with catgut and the skin closed, with the insertion of a small rubber tissue drain at the lower angle of the wound. A plaster-of-Paris splint was then applied.

During the course of the child's convalescence, a series of X-ray pictures were taken, which were shown by Dr. Russell with the aid of the lantern-slide to illustrate the gradual re-formation of new bone from the periosteum. The wound was dressed and the sutures removed nineteen days after the operation, and there was primary union throughout. When the patient left the hospital, on February 12, 1912, she was able to walk, and at the present time, two and a half years after the operation, the tibia was practically of normal size and the child had full use of the limb. There was no shortening.

Dr. Russell presented also a boy, who had been presented before to this society. At the time of his admission to the Roosevelt Hospital, on March 2, 1909, he was six years old. His illness then dated back one week, when, without injury or other apparent cause, he began to complain of sharp pain in the right leg, extending down from the knee to the toes. On the following day the leg became swollen, reddened and tender, especially just below the knee-joint. The pain appeared to be worse at night.

Examination, at the time of admission, showed a reddened, indurated area extending from the right knee to the ankle. The upper portion of the anterior surface of the tibia seemed to be especially involved; this area was very tender and apparently very painful upon passive flexion and extension of the knee-joint. At the point of attachment of the patellar tendon there was a slight sense of deep fluctuation, and pressure upon any part of the upper half of the tibia caused severe pain. There was no definite fluctuation in the knee-joint, and the foot was apparently normal.

The case was regarded as one of acute osteomyelitis, and, on March 2, 1909, an incision was made over the tibia and carried down to the bone, evacuating a large quantity of pus. As there was fluctuation over the periosteum, this was opened and more pus evacuated. The upper part of the shaft of the tibia was now opened with a gouge and a small pus cavity evacuated. The wound was packed with wet bichloride gauze (1–5000), covered with a dry gauze dressing, and a posterior splint applied.

After this operation the patient failed to improve. The high temperature persisted, and the infection gradually spread into the adjacent soft parts, forming an extensive cellulitis just below the knee-joint. On March 29, 1909, Dr. Russell performed subperiosteal resection of the tibia. The incision was carried through the periosteum, which was stripped from the entire shaft of the bone and retracted. The bone was now sawn through just below the epiphyseal line at either end, and the shaft removed. The periosteum was then sutured with interrupted plain gut, approximating the two edges as closely as possible, thus filling in the space formerly occupied by bone. The skin was closed with silkworm gut and a strip of iodoform gauze inserted at the upper end of the wound.

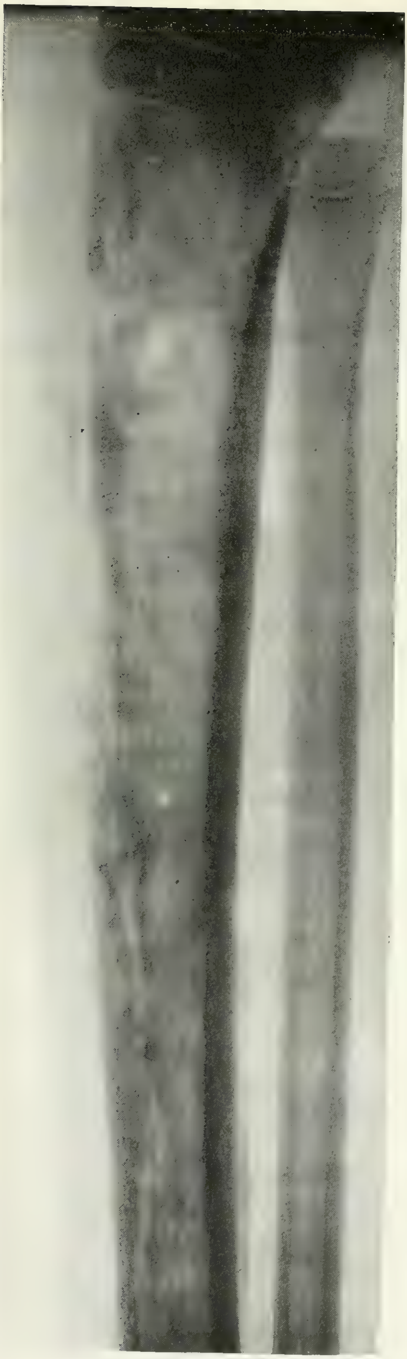
A pathological examination of the specimen of bone showed that the entire shaft was filled with pus. The cortex was somewhat thickened and had a worm-eaten appearance. The periosteum was much thickened and was readily stripped from the bone.

After the first operation, on March 2, there was no complaint of pain in the leg until the sixth day. Very severe pain was then complained of, and the X-ray showed the extension of the osteomyelitic process, so that on March 29 the tibial bone was entirely resected. The tension sutures were removed on the fifth day after this operation. An X-ray, taken on April 21, 1909, showed a new formation of bone inside the periosteum. On May 7, the patient fell out of bed, sustaining a fracture through the lower third of the right femur. His further convalescence was uninterrupted, and a series of X-ray pictures taken during the following months showed the progressive formation of tibial bone, although the outline of the tibia was very irregular. The temperature, which was usually normal, at times fluctuated between 99° and 100°. The patient's general condition gradually improved, and the X-ray showed a steady strengthening of the tibia, its outlines becoming more definite and regular. Various plaster splints were applied and re-applied, until, at the time of his discharge from the hospital, on March 4, 1910, the patient was able to go about on crutches and could place a great deal of weight on the affected leg. The incision of the operation had entirely healed. Pathologically, the case was pronounced one of acute suppurative osteomyelitis, with no evidence of tuberculosis. Now, five years after, he had been perfectly well, with no recurrence. The wound remained healed, and the last X-ray, taken a few days ago, showed a firm though somewhat irregular bone.

OSTEOMYELITIS OF THE FIBULA.

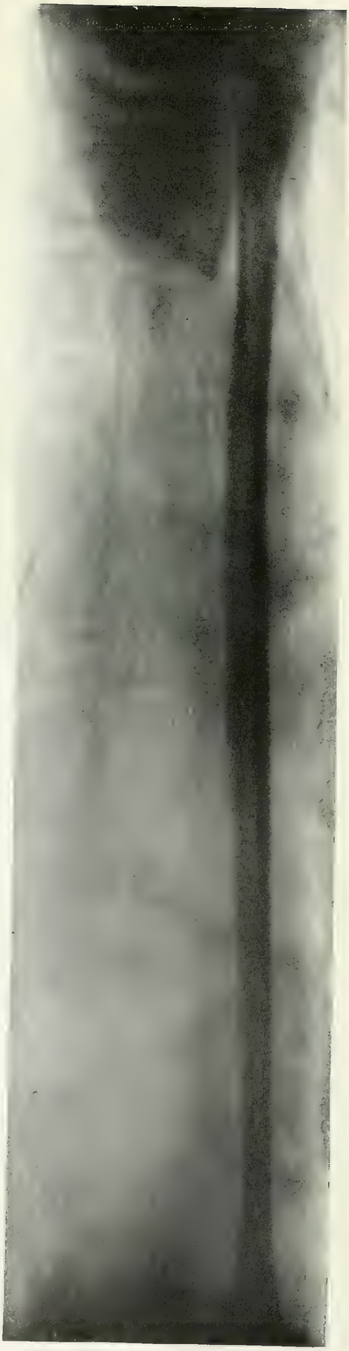
Dr. Russell presented a boy, two and a half years old, who was admitted to the Roosevelt Hospital on April 16, 1913, with the history that eight months previously the right lower leg had become swollen, painful and tender. The family physician was consulted, who incised the leg several times, with the evacuation of pus, and resulting in the formation of a discharging sinus. On April 19, 1913, Dr. Russell did a subperiosteal resection of the fibula from epiphysis to epiphysis, as in the two previous cases.

FIG. 1.



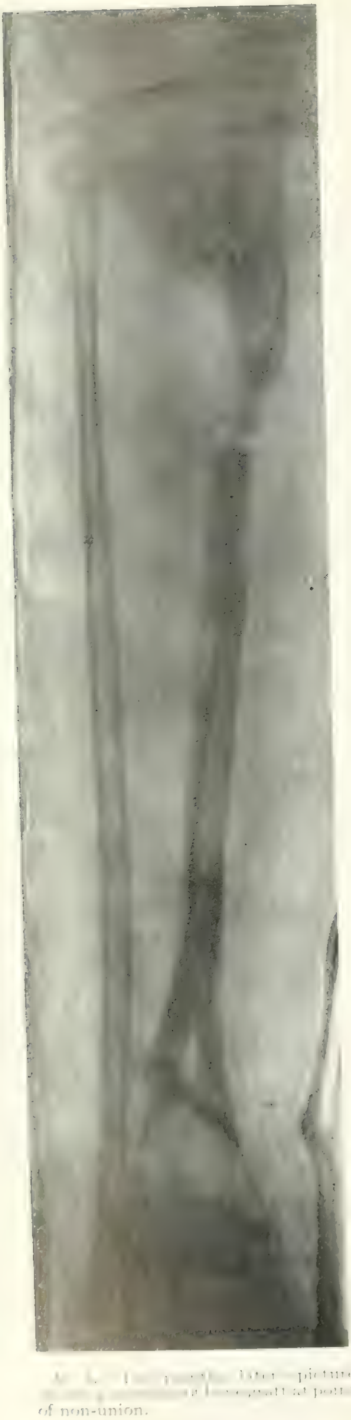
R. L. X-ray taken before removal of tibial shaft. The amount of bone involved is clearly shown.

FIG. 2.



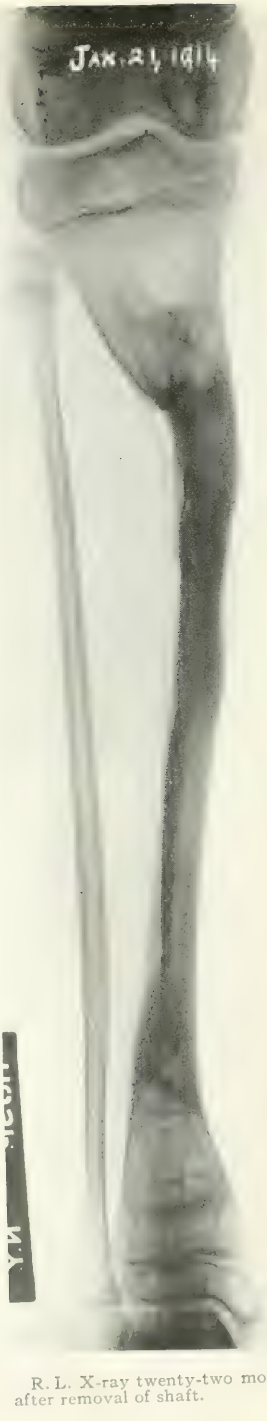
R. L. X-ray two weeks after removal of bone.

FIG. 3.



R. L. [illegible] months later; picture [illegible] at point of non-union.

FIG. 4.



R. L. X-ray twenty-two months after removal of shaft.

The temperature reached normal on the second day after the operation, and the patient's convalescence was uneventful.

The series of X-rays showed a developing bone which had not yet completely re-formed. Dr. Russell said that after waiting for some time, if the bone did not completely re-form, he would do a bone graft.

RE-FORMATION OF TIBIA AFTER OSTEOMYELITIS.

Dr. William A. Downes presented this case, with lantern slide illustrations (Figs. 1–4). The patient was a girl, eight years old, who was admitted to St. Francis Hospital on March 13, 1912, with the history of pain and swelling in the left leg, just below the knee, of one week's duration. The temperature, on admission, was 102°, pulse 140, and the child was apparently very ill. Examination showed a spindle-shaped swelling involving the upper part of the leg.

Under general anæsthesia, a four-inch incision was made over the anterior surface of the leg, and a large amount of pus evacuated. The epiphysis and upper half of the shaft of the tibia were entirely bared of periosteum. The wound was left open. The child's condition improved, and on April 3 the incision was carried down to the lower epiphysis of the tibia, and a subperiosteal resection of practically the entire shaft of the bone was done. A small portion of the upper and lower ends of the diaphysis were apparently healthy, and these were left. As there were no symptoms of infection at this time, the wound was closed and a plaster-of-Paris case applied. The wound healed rapidly, and by July 3 the X-ray showed considerable bone formation.

On November 23 the picture showed that regeneration of bone was proceeding rapidly, but that non-union existed between the newly formed bone and the upper remaining portion of the tibia. The condition was practically unchanged on December 26, 1912.

On the 18th of the following February, when the child was re-admitted to the hospital, there was marked regeneration of bone, but the point of non-union was still present. A bone graft, an inch and a half long, was removed from the opposite tibia and inserted at the point of non-union, and the plaster case re-applied.

On March 10, 1913, the wound was healed throughout, and the X-ray showed some new formation of bone at the site of the graft. By May 17, there was firm union at this point, and by July 21, the tibia was re-formed throughout. The plaster was then removed, and a hip splint applied.

At the present time (January, 1914) the X-ray showed a perfectly solid tibia, at least two-thirds the size of the normal bone, and the point at which the graft had been inserted could no longer be made out. The knee and ankle joints were in perfect condition; there was no shortening nor deformity, and the child had complete use of the limb.

Dr. Charles N. Dowd asked in which class of cases it was best to do a complete subperiosteal resection of the diseased bone, instead of leaving a thin shell of bone to help maintain the shape of the bone and assist in its re-formation, as had been recommended by some, who claimed that this latter method gave better results, and that complications were less apt to occur. In one case, Dr. Dowd said, where the entire bone was bathed in pus, he left a thin, posterior shell of bone, and his results, he thought, were better than if the entire bone had been resected. Shortening was less likely to occur, and the re-formation of bone progressed more rapidly.

Dr. Russell said that in the very acute cases, such as one of those he had shown, where the operation was done about six weeks after the onset of the disease, he sutured the periosteum and also the external wound, leaving only a small drain. In this case there was slight suppuration of the skin wound, but this subsided in a few days and the wound then closed. In one of the other cases he closed the wound entirely and primary union followed. This of course was unusual in osteomyelitis, and he had emphasized it for that reason. There had been no complications in any of his cases, barring the fracture of the thigh in one case, which was of course purely accidental.

As for leaving a thin shell of bone, as suggested by Dr. Dowd, it seemed to him extremely difficult to accomplish this in dealing with a diseased tibia without fracturing the bone. His own results had been better by doing a complete subperiosteal resection than by the older methods.

Dr. Downes said that in his case, at the time of the second operation, the child showed every evidence of having had a severe infection, and the blood supply of practically the entire diaphysis had been cut off. The section of the tibia that he had removed looked like perfectly dead bone, and in this case, at any rate, there was no possibility of leaving a posterior shell. The importance of leaving the periosteum was well illustrated by comparing the result in this case with one that had come under his observation where the periosteum was evidently destroyed, and a complete loss of the diaphysis resulted. The patient had a six-inch shortening and a useless leg.

Dr. Arpad G. Gerster said the patients shown were all children, in whom the process of bone regeneration was much more active than in grown people. The character of the attacks, too, was apparently of a comparatively mild type. In some cases of osteomyelitis the patients were so extremely ill and the destruction of tissue so extensive that this method of treatment could not be carried out at all; for example, in very septic cases, with a gangrenous periosteum, and great destruction of tissue resulting from tension. In the milder cases, the old-time methods of treatment would probably have given equally good results. This new method was particularly indicated, he thought, in old, sluggish, chronic cases, with discharging fistulæ, the patients wandering from one hospital to another and remaining uncured until the nidus of infection was radically removed.

This entire subject, Dr. Gerster said, was a very important and interesting one, but we should not lose sight of the fact that we could not resect and save every bone in osteomyelitis. We could not generalize; every case had to be treated on its own merits, this by one method and that by another. More study of the varieties of suppurative osteomyelitis, and more precision as to an intelligent indication based on pathological condition, were necessary.

ARTERIOVENOUS ANEURISM OF THE SUPERIOR THYROID ARTERY AND VEIN.

Dr. William A. Downes presented a woman, thirty-five years old, unmarried, who was admitted to the New York Hospital on April 22, 1913, with the history that seven years ago she was operated on for goitre in a hospital in Pittsburgh. Judging by the history, the goitre was probably of the exophthalmic type and about the size of an orange. Six months later she began to notice a throbbing in the right side of the neck, occasionally accompanied by a sharp pain. This continued until about four years ago, when she had a severe, sudden, sharp pain which lasted several days, and was soon followed by a swelling in the right side of the neck. Accompanying this swelling was a purring sound. The swelling gradually increased until it reached the size of a goose egg.

Examination at the time of the patient's admission to the hospital showed the usual signs of an aneurism, and from its location it was thought to spring from the common carotid artery. However, on operation, which was done by Dr. Downes on April 22, 1913, the aneurism was found to have formed between the superior thyroid artery and vein, and he was able to ligate the artery between the external carotid and the aneurism, and similarly the vein leading into the aneurism, and then remove the aneurismal sac *in toto*. It was about the size of a hen's egg, and besides the artery and vein, entering the proximal pole of the sac, there were two small vessels attached to its distal end which disappeared under the muscles across the median line. The patient made a perfectly satisfactory recovery.

ARTERIOVENOUS ANEURISM OF THE FEMORAL ARTERY AND VEIN.

Dr. George D. Stewart presented a police officer, thirty-eight years old, who, in July, 1911, while making an arrest, was shot five times, three of the bullets entering the arm, one penetrating the lower part of the abdomen and one the groin. As a result of the latter, he developed a tremendous hæmatoma of the scrotum, and when he left the hospital at the end of 46 days, there remained a tumor in the right femoral space, which was recognized as an arteriovenous aneurism.

When Dr. Stewart first saw the patient, in November, 1911, this tumor in the right femoral region was present. It gave a distinct thrill, and was undoubtedly a communication between the right femoral artery and vein. As a preliminary measure, continuous pressure was applied over the swelling with little or no effect.

Operation, December, 1911: Upon exposing the tumor, the artery and vein were found lying side by side, and merged for a distance of about three inches. Instead of proceeding in the usual way, Dr. Stewart said he acted upon a suggestion made by his assistant, Dr. Arthur M. Wright, and created a new partition between the artery and the vein by taking a fine needle, similar to that used by Carrel in doing his arterial anastomosis, and inserting a double row of sutures between the two vessels. The needle was passed back and forth, the interrupted stitches being placed very close together, covering the entire distance where the vessels were merged together, until finally the thrill in the artery ceased. By this method the vessels were not opened, and no blood was lost. Since the operation, which was done in December, 1911, there had been no return of the thrill, and the patient had remained entirely well.

Pulsation in the artery below the aneurismal communication was noted during and after the operation, when it was apparently increased in volume. As the pulsation still persists in popliteal dorsalis pedis and posterior tibial there has probably been no clotting at the site of operation.

Dr. Gerster said the case shown by Dr. Stewart was certainly treated on very original lines, and as far as safety was concerned, it was very commendable, as the interior of the blood-vessels was not invaded. It would be interesting to study the specimen of a case thus treated. Evidently a collateral circulation had been established before this aneurism developed, and the result, perhaps, would have been just as good if the vessels had been tied.

EXCISION OF GASTRIC ULCER, FOLLOWED BY HOUR-GLASS CONTRACTION OF THE STOMACH.

Dr. F. Kammerer presented a patient who had come under his care a year ago for a chronic ulcer of the stomach. At operation, a perforating saddle-ulcer, involving more of the posterior than the anterior surface of the stomach and firmly imbedded in adhesions, was found about midway between the cardia and pylorus on the lesser curvature. The ulcer was removed by a wedge-shaped excision, taking in about two-thirds of the transverse diameter of the stomach. After the defect in the latter had been closed by several rows of sutures it was evident that considerable tension was now exerted upon the pylorus, but the condition of the patient was such that an additional gastro-enterostomy was deemed inadvisable. A small tampon was introduced for a few days through the upper angle of the wound. The patient's recovery was rather stormy, a large intraperitoneal abscess forming on the right side, which had to be opened at the end of the second week. Finally, healing took place, but after half a year the patient was again put on the operating table for gradually increasing symptoms of gastric retention. At the second operation, what appeared to be a normally shaped stomach, somewhat small, was found firmly fixed by adhesions against the posterior abdominal wall and spinal column. A posterior gastro-enterostomy being out of question, the anterior operation was done with a Murphy button, and an entero-enterostomy added. The desired effect did not follow this procedure, although the button was passed during the second week. The condition of the patient grew steadily worse. He lost weight, was nauseated after meals, vomited frequently, and was greatly relieved by lavage of the stomach. X-ray examination showed a dilated stomach lying somewhat to the left of the median line, filled with bismuth, and an intestinal shadow, beginning about three inches above the lowest point of the stomach to the right, giving the impression of a contracted gastro-enterostomy opening. At a third operation during November, the anastomosis between the stomach and intestine was found to easily admit two fingers, the pylorus was open and the stomach appeared as it did at the last operation, about six inches long and three or four inches wide, with a well-developed larger curvature meeting the lesser curvature in dense adhesions beneath the left costal border. To expose all these parts a great many adhesions had to be separated, and, thinking that the latter had perhaps prevented the proper functioning of the entero-enterostomy and had established a kind of vicious circle, the stomach was divided near the pylorus and both ends closed in the hope of forcing the gastric contents through the gastro-enterostomy. There was not the slightest amelioration in the patient's condition following this third operation. Several further X-ray plates were taken. On comparing these with the former plates, the speaker was, for the first time, struck by the fact that the stomach in the plates was invariably situated further to the left than he had found it at operation, and then, also for the first time, the possibility that we had been dealing with two different cavities at the X-ray examinations and the later operations suggested itself. A fourth operation cleared up the situation entirely. After separation of dense adhesions to the left, the cardiac pouch of an hourglass stomach was exposed. A second gastro-enterostomy was done, uniting this pouch with a lower coil of intestine, and also a second entero-enterostomy. The patient was immediately relieved of all his symptoms.

After the first gastro-enterostomy, the efferent loop of jejunum had been drawn over by adhesions to the left, toward the cardiac pouch of the stomach, and, when later on a bismuth meal was given, a small portion of the latter evidently passed into the pyloric pouch and then into the efferent loop of jejunum, giving the impression on the X-ray plate that the anastomosis was situated at the point where this loop was attached to the cardiac pouch. In reality, gastro-enterostomy had been done with the pyloric pouch. The case demonstrated the difficulties of secondary operations after extensive adhesions in the abdominal cavity, and also difficulties in the way of a correct interpretation of some X-ray plates.

Dr. Gerster said some very practical conclusions could be deduced from the case shown by Dr. Kammerer. One was the great importance, when the abdominal cavity was opened, to ascertain the anatomical condition of the parts under the guidance of the eye—not touch alone. This fact had been impressed upon him many years ago, when, after removing a tumor of the cæcum, he trusted to his sense of touch in making what he supposed to be an anastomosis, instead of which he formed a vicious circle which resulted fatally.

Dr. Gerster said that in two cases of saddle ulcer located on the lesser curvature of the stomach, he had followed practically the same procedure as that described by Dr. Kammerer, and after the excision of a large segment of the stomach wall, the normal configuration of the stomach was lost, and in one of the cases, where death occurred five days after the operation, the autopsy showed that the lesser curvature was entirely absent. In both of those cases he did a gastro-enterostomy. In a recent case, the ulcer was located midway between the pylorus and cardia, closely approaching the site of a previous gastro-enterostomy. A resection was contemplated, but how to proceed was rather puzzling. Posteriorly was the stoma of the old gastro-enterostomy, and in order to leave this undisturbed he cut through the pylorus and did a right-angled resection, leaving a stomach that resembled a segment of large intestine. In this case, malignancy was subsequently demonstrated in the specimen.

Dr. Howard Lilienthal, speaking of the troublesome adhesions that Dr. Kammerer had encountered, said he was inclined to believe that if gauze packing was prevented from coming in contact with the gut throughout the entire operation, the subsequent formation of adhesions, particularly in the upper abdomen, would be minimized. To prevent this contact between the gauze and abdominal contents, he had found the suggestion made by a writer many years ago an excellent one. It consisted in the use of a strip of stout rubber dam; into this a small hole was punched, and through this opening (stretched) the tissue or organ upon which it was intended to operate was drawn. This gave an absolutely clean field, and when the operation was complete the parts were returned to the abdominal cavity without the hand or gauze having come in contact with the peritoneum: nothing but retractors, rubber gloves and instruments.

Dr. John A. Hartwell said he recently had a case very similar to the one shown by Dr. Kammerer, where a large saddle ulcer extended from the pylorus over both the anterior and posterior walls of the stomach. In that case he did a resection much like that described by Dr. Gerster, and closed the upper end of the pylorus. He then did a posterior gastro-enterostomy. The immediate result of the operation was good, but death occurred within a few days, and the autopsy showed that while the wound in the stomach had healed satisfactorily, there had been a severe peritonitis in the lesser sac. In this case, a preliminary gastro-enterostomy had been contemplated, but the patient's suffering was so intense that it was decided that it would not answer the purpose.

Dr. Downes said that about four years ago he looked up the subject of hour-glass stomach, and found at least half a dozen cases reported in which gastro-enterostomy had been performed where the distal pouch had been used instead of the proximal in forming the union between the intestine and stomach, with the result that the cases had gone on to fatal termination. He thought Dr. Kammerer was to be congratulated upon making the discovery early enough to correct the condition and save his patient.

Dr. Kammerer, in closing, said he thought the adhesions in this case were due to the large intraperitoneal abscess which formed after the first operation. He agreed with Dr. Gerster that as much of the field of operation as possible should be brought under the eye, but in this instance the adhesions were so abundant and firm that he did not feel justified in trying to separate them during the later operations without a distinct indication.

RESECTION OF THE FEMORAL VEIN FOR THROMBO-ANGEITIS OBLITERANS.

Dr. Howard Lilienthal presented a man, thirty-two years old, who was admitted to the Mt. Sinai Hospital on November 15, 1913, suffering from a thrombo-angeitis obliterans affecting both lower extremities. Five years ago he had been a patient there with the same disease, and was discharged unrelieved. Two years ago he had returned to the hospital complaining of numbness and pain in the left foot, his previous trouble having been limited to the right foot. He remained in the hospital almost a year, and during that time four toes on the left foot and one toe on the right foot were amputated. With very slight remissions, the symptoms had progressed, an ulcer at one of the cicatrices of the left foot having failed to heal, and giving rise to constant, severe pain. He also complained of numbness in his fingers.

At the time of his present admission there was no pulsation in either foot. The feet were much reddened. The veins in both lower extremities were apparently very small, and there was an ulcer the size of a silver quarter of a dollar in the line of the former amputation. The pulse was 120; respirations, 24; temperature, 100.6°. The urine was normal.

The patient was seen by Dr. B. Sachs, who expressed the opinion that it was one of incipient Raynaud's disease. The pain was excessive, and could not be relieved by any form of dressing. The patient having expressed a desire for amputation, Dr. Lilienthal advised arteriovenous anastomosis as a preliminary measure, with the hope of postponing the necessity for amputation.

Operation, December 8, 1913: Upon exposure, the femoral artery was found to be of normal size, the only apparent abnormality being the increase in the number of vasa vasorum. The femoral vein, however, at the beginning of Hunter's canal was very much smaller than the artery, and its walls were greatly thickened. The operation originally planned, therefore, was abandoned, and the femoral vein was doubly ligated and a section removed between the ligatures. The operation of ligating the femoral vein in this condition, Dr. Lilienthal said, had been advised by Coenen and others. (See Dr. Leonard Freeman's paper, *Trans. Amer. Surg. Assoc.*, 1913.) The wound was closed by deep and superficial sutures.

There was no particular change apparent in the circulation of the foot immediately after the operation. A few days later, however, the patient stated that there was some relief from the intense pain, and the circulation of the foot was certainly no worse than it was prior to the operation. From this time on the patient improved rapidly and, by January 20, 1914, the ulcer had practically healed, the pain had entirely disappeared and the patient insisted on returning to his home.

THROMBO-ANGEITIS OBLITERANS: MULTIPLE LIGATION OF VARICOSE VEINS OF THE LEG.

Dr. Lilienthal presented a man, fifty-one years old, who for three years had suffered from the characteristic pain and other symptoms of a thrombo-angeitis obliterans. The left foot was the one principally involved. The pain extended up the calf of the leg, and became so severe that amputation was consented to.

On December 26, 1913, it was Dr. Lilienthal's intention to ligate the femoral vein, but after the patient was on the table it was decided instead, as a preliminary measure, to ligate the large, multiple varicose veins of both legs, and this was accordingly done by Dr. Ira Cohen, the house surgeon. Following this procedure, the patient was completely relieved of his symptoms, and left the hospital about two weeks after the operation.

Dr. Lilienthal said that in both of these cases, as, in fact, in all the cases that had come under his observation, the patients were addicted to the excessive use of cigarettes.

Dr. William C. Lusk said he thought the probable syphilitic nature of endarteritis obliterans should be taken into consideration. In the case he had shown before the Society last spring (Annals of Surgery, November, 1913, p. 670) in whom the symptoms had been relieved and function was becoming restored in conjunction with the use of the Schnee four-cell electric bath, during the past summer the sinus in the little toe had grown larger and bone became exposed in its bottom, and there was some slight return of the pain, which, it seemed, could practically be held in abeyance by the daily use of the electric bath. Mixed treatment for about 4 weeks, followed by neosalvarsan 0.45, had caused no marked improvement, but after a second dose of salvarsan (old) 0.2 the sinus quite suddenly, in the course of 10 days, healed up completely. Also the tendency to pain then promptly diminished and, with regular injections of mercury and an occasional salvarsan, disappeared completely. This patient had a history of syphilitic infection, but his Wassermann, on repeated taking, had always been negative or doubtful. In a second case referred to him by Dr. C. G. Burdick, treated with the electric bath, while the pain was generally relieved for a number of hours following the bath, yet the foot was very swollen and a commencing gangrene spread, so that the foot had to be amputated. The treatment of two other cases had been begun about two weeks previously. One of these, referred by Dr. H. H. Janeway, had a history of syphilitic infection 9 years ago, though the Wassermann was now negative. The left foot had been amputated. The right foot was a little swollen and on the inner side of the great toe there was an ulcer about ½ inch in diameter, of 4 weeks' growth, and in and around the great toe there had occurred attacks of burning pain for 3 weeks, mostly at night. The treatment had consisted of intramuscular injections of salicylate of mercury at five-day intervals, 10-grain doses of potassium iodide, and a daily four-cell electric bath. At the present date the ulcer had already scabbed over and was now perfectly dry, and the foot was no longer swollen. For the past two nights the patient had slept in perfect comfort.

Note.—February 13, 1914. The patient is now entirely free from pain and is active. Baths stopped February 3. Antispecific remedies continued.

The other case was one in the service of Dr. T. A. Smith at Bellevue Hospital and was of an advanced type. He had, before the present treatment, suffered uninterrupted pain for 9 months, the great toe had become gangrenous, the adjoining skin was cyanotic and the whole foot swollen. Wassermann strongly positive. In the past 2 weeks the patient had been given injections of mercury, small doses of potassium iodide and a daily electric bath, with the result that following the bath there had generally resulted several hours of respite from pain. Dr. Lusk said that the electric bath for the relief of pain in these cases was best used with a current of 10 ma. for 10 minutes.

Dr. A. V. Moschcowitz said he had long been under the impression that this was a disease in which syphilis could be ruled out. They saw many of these cases at Mt. Sinai Hospital, and most of them did not give a syphilitic history, nor was the

Wassermann reaction positive. Because some of these patients were improved by mixed treatment and salvarsan, it did not prove that they were necessarily syphilitic, and if the Wassermann was negative, we might safely assume that syphilis could be ruled out. The disease seemed to be especially prone to occur in men of Jewish extraction who were heavy cigarette smokers, but a number of cases had been reported by the surgeons in soldiers of Christian and Mohammedan religions, who served in the recent wars in the East.

DR. GERSTER said that Dr. Leo Buerger had recently written a very creditable work on the subject of this disease, but the result of his pathological studies still left us in the dark as to the essential etiological factor that gave rise to it. Whether it was tobacco, race, or syphilis, we did not know. We did not know why the blood-vessels of these particular patients degenerated in this particular fashion. Dr. Lilienthal had presented several cases where interference with the venous circulation produced a marked improvement in the subjective symptoms of the disease, of which the predominating symptom was the pain, which was so intense and persistent that the patients could not get any relief without the aid of opiates. Why should the resection of the veins relieve the pain? In other cases that had been reported, an arteriovenous anastomosis had produced a similarly beneficial result. Lacking a better theory, Dr. Gerster said, he would make the suggestion, that as most of these patients were extremely neurotic, and not of the phlegmatic type, that is over-sensitive to pain, it might be assumed that this or any other form of operative treatment acted the line of suggestion analogous to the temporary relief from epilepsy after certain operations on the skull or elsewhere.

DR. HARTWELL said they had one case of endarteritis obliterans, at Bellevue Hospital, where one leg had to be amputated and the other was affected. That patient had never smoked, while his father, who was an inveterate smoker, had lived to the age of 83 without developing this disease.

DR. LILIENTHAL said that in all of their cases the usual tests for syphilis had been made, with negative results. While they had not tried the electrical baths, to which Dr. Lusk referred, they had tried electricity without any benefit.

Replying to Dr. Gerster, the speaker said this was a disease of men, not women, and the latter were generally more neurotic than the former, and for that reason he thought a neurosis could be ruled out. Besides, a neurosis would not explain the pathological changes found in the arteries. In two of the cases he had seen, the patients subsequently became insane, possibly from arterial changes in the brain. In addition to the pain, the appearance of the extremities indicated some real pathological condition, and in one of the cases examined by Dr. Buerger, there was ossification and obliteration of the vessels. Aside from arteriovenous anastomosis and the relief following the operative procedures in the two cases shown to-night, amputation had hitherto been the only recourse.

Dr. Gerster said he did not wish to be understood as claiming that this malady itself was a neurosis; only that the excessive pain was possibly neurotic in character. The operation described by Dr. Lilienthal was certainly a valuable addition to our knowledge in the treatment of these cases, even if the results obtained by it could not be explained on pathological grounds.

ANTERIOR DISLOCATION OF THE HEAD OF THE RADIUS, WITH FRACTURE OF THE ULNAR SHAFT: OPEN REDUCTION.

Dr. William Darrach presented a girl, four years and five months old, who on May 25, 1913, fell off a toy wagon, striking her forearm on a stone. The forearm was put up in splints within a few hours after the accident, and four weeks later, when the splints were removed, motion at the elbow was found to be limited.

A week later, a number of X-ray pictures of the joint were taken for the first time, and the patient was referred to Roosevelt Hospital. At this time, flexion at the elbow was possible to 80 degrees (10 degrees beyond a right angle), and extension was possible to 160 degrees (within 20 degrees of a straight angle). Pronation and supination were both limited to one-half the normal degree, and the head of the radius could be distinctly felt displaced forward. The X-ray showed a fracture through the upper part of the ulna, with moderate anterior bowing. On July 2, thirty-eight days after the injury, under gas and ether anæsthesia, a curved incision was made over the dorsal, lateral aspect of the forearm, extending from the line of the elbow joint downward for a distance of three inches. The ulnar fracture was broken up, and the head of the radius approached from behind the radial carpal flexor. The radial head was found lying anterior to the capsule. An attempt was made to reduce the dislocation by traction, but the opening in the capsule was too small to admit the head.

A vertical incision was made through the orbicular ligament, and a chromic suture passed through the mesial edge. This was then passed around the neck of the radius from behind forward, and to its inner side, the orbicular ligament being thus drawn around the head and neck of the radius, the latter easily slipping back into its normal position. The suture was then passed through the lateral edge of the cut ligament and tied, approximating the cut edges. The wound was then closed, using catgut for the deeper planes and silk for the skin. A plaster bandage was then applied, extending from the middle of the arm to the metacarpal region, with the elbow at right angles. The plaster was removed after three weeks, when the wound was found healed and the stitches were taken out. Flexion was now possible to 70 degrees, extension to 150 degrees and supination and pronation each one-quarter. The X-ray showed that the radial head was in its normal position, with good alignment of the ulna. A week later flexion was still limited to 70 degrees, extension to 170 degrees, while pronation and supination had increased to one-half the normal amount. On January 28, 1914, almost seven months after the operation, flexion was possible to 30 degrees, extension to 200 degrees, (20 degrees beyond a straight angle), while pronation and supination were complete and there was no pain or decrease in power. The radial head could be felt in its normal position.

FRACTURE OF THE ASTRAGALUS, WITH DISLOCATION BACKWARD OF THE POSTERIOR FRAGMENT: REMOVAL OF THE FRAGMENT.

Dr. Darrach presented a man, twenty-two years old, who on March 17, 1913, while attempting to climb on a moving wagon, caught his foot in the spokes of the wheel. The foot was forcibly everted and rotated outward, and was said to have been dislocated outward, the skin over the internal malleolus being broken. He was taken to a hospital, where the foot was pulled back into position and bandaged, and on the following day he was allowed to go home. Eight weeks later he came to Roosevelt Hospital complaining of inability to walk because of pain below the internal malleolus and in front of the tibiotarsal joint. On examination, the right ankle was widened in the region of the malleoli and for a distance of an inch below. Just anterior to the tendo Achilles there was a firm swelling, the size of a golf ball, which was very slightly movable on the underlying parts. It was not adherent to the overlying skin. There was no motion at the tibiotarsal joint, and the movements at the mid-tarsal joint were greatly limited. There was a scar just above the tip of the internal malleolus. Just underneath this there was marked tenderness, as well as over the lower tibial margin in front. The head of the astragalus could be felt in its normal position. An X-ray examination showed that there had been an oblique fracture of the astragalus, the anterior fragment consisting of a head, neck and the portion of the body adjacent to the interosseous groove. The rest of the body, containing the tibial, fibular and posterior calcanean articular surfaces, had been displaced backward. There was also a fracture of the lower extremity of the tibia involving the internal malleolus and adjacent portion of the anterior lip.

On May 16, 1913, under gas and ether, a curved incision was made behind and below the internal malleolus, and the posterior fragment shelled out of its bed and removed. After the removal of this, as the foot could now be flexed and rotated inward sufficiently to bring it well under the axis of weight-bearing, it was decided to leave the anterior fragment in place and see how much functional return would result. The wound was closed, and the foot and entire leg inclosed in a plaster-of-Paris bandage, the foot being flexed and inverted as much as possible. There was no reaction after the operation, and the patient left the hospital at the end of a week. The plaster was taken off at the end of three and a half weeks, when the stitches were also removed, the wound having healed primarily.

The patient returned to work three months after the operation, but still complained of pain referred to the front of the tibiotarsal joint. He then had 20 degrees of motion at this point. Six months after the operation there was still some pain below and in front of both malleoli when he first began to walk on it each day. This disappeared after about fifteen minutes, and did not return until after six or seven hours of continuous work. Building up the inner side of his shoe and the wearing of a metal arch support had decreased his pain and improved his gait. Eight months after the operation there was almost no pain in the ankle, and he walked without a limp. There was still a little pain when he first began to use it in the morning.

In view of the very satisfactory result in this case, Dr. Darrach said, it seemed wise not to remove the remaining portion of the astragalus in such cases, if the foot could be maintained in such position as to be well under the line of weight-bearing, and with sufficient flexion at the tibiotarsal joint to allow the toes to clear the ground without outward rotation in walking.

PROSTATECTOMY IN A GENERAL SURGICAL PRACTICE.

Dr. Howard Lilienthal read a paper with the above title, for which see page 373 (March).

Dr. Hartwell thought that in many cases of enlarged prostate that were seen during a comparatively early stage, the prostatectomy could be completed at one sitting without any additional risk to the patient. In the class of cases described by Dr. Lilienthal, of course, the two-stage operation possessed distinct advantages. In doing the suprapubic operation, the speaker said, the possibility of a subsequent hemorrhage was always in his mind, and in one of his recent operations he recalled an article by Cabot, of Boston, who claimed that the bleeding was arterial, not venous, that these vessels were located in the mucous membrane, and that they could be seen by careful retraction of the parts. In this particular case, Dr. Hartwell said, after removing the prostate and retracting the tissues, he located four small spurting arteries in the mucous membrane, and after ligating these, the field remained perfectly dry.

Dr. Kammerer said he had done only the suprapubic operation during the past six years. He was not quite sure that the statistics presented by Dr. Lilienthal of the one-stage and two-stage operations gave a correct estimate of the value of the two procedures, as perhaps a number of cases with infected bladders had been subjected to a one-stage operation in the early days of prostatectomy, which would now be subjected to a preliminary cystostomy. He himself believed that the one-stage operation was justified where no infection had occurred. Postoperative hemorrhage after suprapubic prostatectomy, coming on several hours after operation, when the patients had been returned to the wards, had given the speaker more trouble than any other factor in the management of these cases. In six cases he had packed the bed of the prostate with gauze, bringing one end out through the incision into the bladder and fixing the tampon in place by two or three interrupted plain catgut sutures passed through the mucous membrane of the bladder and the prostatic capsule (see ANNALS OF SURGERY, vol. 53, page 429). These sutures opened up in a few days and the tampon could be readily withdrawn. He had never seen anything suggesting retention in the bed of the prostate when this plan was followed. In four late cases he had tried Judd's suggestion of permanent irrigation of the bladder, and he was much impressed by its ability to prevent postoperative hemorrhage.

DR. GERSTER said he thought the two-stage operation in the class of cases reported by Dr. Lilienthal certainly seemed advisable, and the results he had obtained bore out his contention. By doing the operation in two sittings, shock was lessened, and as the first stage was done under a local anæsthetic, it scarcely counted. The rate of mortality he had reported was not high, considering the number of cases and the class in which it was performed. Some surgeons refused to operate in certain cases, fearing to increase their death rate, thus depriving some patients of the benefit they might derive from an operation.

Dr. Gerster said the preliminary diagnostic use of the X-ray in these cases as a routine measure, as suggested by the reader of the paper, was commendable. The speaker said its practice might have saved him from two rather disagreeable experiences. In both of these cases there was a large calculus in the ureter, which was only detected after the operation on the prostate had been undertaken. In one, the patient died from sepsis before the presence of the stone was suspected, while in the other it was found during the course of the operation and removed without difficulty.

DR. LILIENTHAL, in closing, said he had not had much trouble from hemorrhage in his cases. In some of his earlier cases, perhaps, the bleeding may have been a contributing factor in the fatal issue, but not in recent years. In comparatively young and middle-aged patients, where the operation could be done at leisure, he had repeatedly searched for and found the bleeding points, as suggested by Cabot, but the operation was a totally different one in old, feeble men, perhaps asthmatic or otherwise disabled. Recently, he had done the operation on a man 85 years old, very stout, with a septic cystitis, asthma and other complications.

When the operation was done in two stages, as he had described, and after removing the prostate, a heavy sand-bag was placed over the lower abdomen to keep the bladder collapsed and prevent the gauze packing from becoming displaced.

The speaker said he was strongly in favor of the preliminary use of the X-ray in all these cases as a routine diagnostic precaution. When he has to deal with a badly infected bladder, he tries to improve the patient's condition before doing the suprapubic operation. During the first stage of the operation, if the hemorrhage was alarming, you knew where to look for it, which was not the case when the operation was completed at one sitting.

Dr. Lilienthal also showed a series of X-ray pictures demonstrating changes in the prostate. In these plates exposure had been made with the bladder full of air and the contrast with the solid prostate was well marked. The method had been devised by Dr. A. Hyman and it formed an additional means for preoperative exact diagnosis.

Note.—It has been since ascertained that a similar method was employed by Burkhart and Flörken (*Deut. Zeit. f. Chir.*, vol. 105). They made use of oxygen gas instead of air.

Dr. A. Hyman (by invitation) said the expedient of filling the bladder with air, as a diagnostic aid in prostatic enlargement, was revealed to him by accident. He had a patient, a man about sixty, in whom calculus was suspected, and it was suggested to dilate his bladder with air in order to bring the outlines of the stone out more distinctly. The X-ray failed to show a calculus, but showed very clearly the outlines of an enlarged prostate. Since then he had resorted to this method in half a dozen cases, and in all of them the enlarged prostate was very distinctly shown. The measure was of course indicated in patients who could not be cystoscoped and where the enlargement of the prostate per rectum was comparatively slight. The radiographs were taken by Dr. Jaches of the Mt. Sinai Hospital X-ray department.

ANNALS OF SURGERY

VOL. LIX JUNE, 1914 No. 6

ORIGINAL MEMOIRS.

THE PROPHYLAXIS OF CANCER.*

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ALL vertebrate animals suffer from cancer in situations which are affected by their habits or conditions of life leading to local lesions in the protective mechanism. We must, therefore, look upon local lesions as an invitation to cancer without regard to just what the actual cause of cancer may be.

If parasitic agencies are the cause of cancer it would appear that their introduction into the human economy was affected through local lesions. The strongest evidence as to the parasitic nature of cancer and the best research on the problem with which I am acquainted is the work on the production of plant cancer by Erwin Smith,[1] which agrees in its main essentials with what we know about cancer as it exists in the human race.

On the other hand, if the cancerous process is one which is brought about by failure to restore normal conditions at the site of a local lesion by means of mature cells and the eventual calling forth of partially differentiated cells of an embryonic type in response to continued irritation, the rôle of the local lesion in either case is as important as is the actual cause.

It is probable that a large majority of human beings possess an immunity to cancer, that a lesser number possess a partial immunity, while a minority are without those protective agencies which render the local lesion ineffective. The term "precancerous," while not strictly accurate, has become allowable through custom and graphically describes a clinical condition, as pointed out by Rodman.[2]

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* The President's Address before the American Surgical Association, April 9, 1914.

The clinician can say with a great deal of assurance that a certain lesion is benign, that another is malignant, but there still exists a number of mid-ground lesions of which he is unable to say that they are either benign or malignant.

The pathologist, by miscroscopic examination, can, in a much higher percentage of cases, definitely establish the benignity or malignancy of a growth. But, there occur certain growths which, even upon minute investigation, he will be unable to diagnose positively as benign or malignant. Sections from such growths sent to different pathologists may bring back contradictory opinions, the majority being undecided.

The microscopic picture which exists in these cases shows a change in character of the cells quite different from the normal but as yet showing no invasion of the surrounding tissues.[3] This invasion is held by most pathologists to be essential in establishing malignancy. Pathologists, however, are striving to establish criteria whereby the change in the character of the cells may be shown to indicate malignancy before invasion takes place. Such microscopic appearance is found in the periphery of malignant growths and in chronic lesions which have been known to later develop malignancy. *The term "precancerous," therefore, strictly should not be applied to all local lesions which may be followed by cancer, but only to those local lesions in which cellular changes are taking place that surpass the normal attempt at repair of the lesion itself, but which are not as yet infiltrating surrounding tissue, the local lesion acting as the invitation, the precancerous stage as its probable acceptance.*

Sites of local irritation may be divided into three general groups:

(1) *Congenital* or acquired neoplasms, such as moles, warts, and benign tumors of various sorts which may undergo

malignancy. Keen,[4] in 1904, called attention to the danger of degeneration of local lesions of this character and presented most interesting and instructive data in regard to their relation to cancer. Bloodgood,[5] in recent years, in a series of remarkable papers on the cancer problem, points out that of 820 pathologically fully developed cancers of the skin and visible mucous membranes, he was unable to find a single case with a well-taken history which showed the absence of a previous defect which might be looked upon as a precancerous lesion.

(2) *Trauma.* Coley[6] calls attention to the influence of trauma not only in the development of sarcoma, which has been an accepted fact for a generation, but also to the fact that trauma has a strong influence in the production of carcinoma. Coley made an analysis of 250 cases of carcinoma which came under his personal observation and the histories of which were taken by himself. There was a history of antecedent trauma in 32.8 per cent. of the cases. The influence of trauma in the production of cancer has also been pointed out by McWilliams,[7] von Bergmann,[8] Röpke,[9] Murphy,[10] Ziegler,[11] Löwenthal,[12] Liebe,[13] von Graefe,[14] and others.

(3) *Chronic irritation*, whether the result of mechanical, chemical, or infectious agencies, is the most important of all those precancerous conditions with which we are acquainted and it is undoubtedly the most potent influence in the development of the disease following congenital lesions and trauma. It is to be noted that cancer in any part of the body which is open to inspection may be shown, in practically every instance, to be preceded by a local lesion. The following well-attested examples may be cited: The development of cancer in the mouth from betel-nut irritation; the cancer of the groin in the chimney sweeps and sailors; the development of cancer following the chemical irritation caused by tar, paraffin, petroleum, arsenic, and aniline products; the development of cancer in local lesions produced by heat, as cancer of the lip from smoking; the "kangri" sores following burns; those cancers on the

shins of locomotive drivers who have been exposed for years to the direct action of heat; cancers following chronic irritation due to different forms of radiant energy, X-ray, etc.; cancers following the local lesions due to infections, such as Bilharzia of the bladder, treponema pallidum in keratosis linguæ;[15] nematodes in testicular tumors in horses[16] and in gastric cancer of rats;[17] and, rarely, the development of cancer in the glands of the neck as a result of the combined chemical and infective irritation of tuberculous cervical adenitis.[18]

A study of some particular forms of cancer which occur in great frequency as the result of a particular form of chronic irritation is most instructive. An interesting instance is the "horn-core" cancer of cattle, due to the irritation of the ropes through the horns with which the cattle pull their loads.[19] Even more extraordinary is the kangri-burn cancer either on the abdomen, thigh, or vicinity, due to the hot kangri fire-baskets which the natives of Kashmir wear on the lower abdomen under the clothing in cold weather. Neve[20] states that from 1890 to 1899, 2020 natives with tumors were operated on at the Kashmir Mission Hospital. Of these tumors, 496 were epithelial cancers, of which 363 were kangri-burn cancers. Equally striking is the betel-nut cancer of the mouth as seen in India. Neblock[21] states that of 976 carcinomas treated in the Madras General Hospital from 1892 to 1901, 411 or nearly 50 per cent. were located in the mouth. Cancer of the lip is rarely seen except in smokers. Cancer of the groin is practically confined to the chimney sweep and the sailor.

Can we doubt that if the kangri fire-basket were not worn by the natives of Kashmir that this strictly localized form of cancer would not exist? If the betel-nut were not used, the enormous preponderance of cancer of the mouth would not exist in India.

The prophylaxis of cancer on the visible portions of the body includes: the avoidance of all those habits and customs which have been shown capable of producing conditions favorable to the development of malignant disease; the removal of all congenital or acquired local lesions such as Keen and Bloodgood have shown to be prolific forerunners of malignant degeneration; and the careful observation of patients for early evidences of malignant change following trauma.

Can our knowledge of the development of external cancer be applied to the solution of the problems of the development of internal cancer? Admitting that the mass of evidence as to the rôle of chronic irritation in its various forms and types is the most important factor in the development of cancer in the parts of the body which are exposed to the eye, must we not conclude that cancer on the inner surfaces of the body depends on the same precancerous conditions? It is difficult to develop evidence as to the early appearance of cancer on the internal mucous surfaces of the body because in the early stage there are, as a rule, no manifestations which lead to a visual examination. Yet we have seen a very considerable number of such early cases and we have observed no instances of early cancer in the mucous membrane of the inner surfaces of the body which did not show the presence of a previous local lesion.

In nearly all the cases of cancer of the gall-bladder which we have had an opportunity to carefully examine, gall-stones were either present or there was evidence to show that they had been present (Fig. 1).[22]

One is impressed with the collateral evidence that the incidence of gall-stones and cancer of the gall-bladder shows the same increased frequency in the female over the male. Can we doubt that early removal of gall-stones might prevent cancer of the gall-bladder? The mortality of an early operation for gall-stones, other things being equal, is less than ½ per cent. Cancer of the gall-bladder occurred in nearly three per cent. of all the cases of cholelithiasis which came to operation in our clinic. We have had no permanent cures after cholecystectomy for cancer of the gall-bladder which had been diagnosed as cancer previous to operation. A number of cures have followed the removal of early cancer incidental to the removal of thick-walled functionless gall-bladders, thus showing that it is not the nature or situation of the malignant process but the delay in diagnosis which is so fatal.

Cancer of the stomach forms nearly one-third of all the cancers of the human body. So far as I know this is not true of the lower animals, nor of uncivilized man. Trustworthy evidence on this point is for obvious reasons difficult to obtain. Why is there this extraordinary frequency of cancer of the stomach? Is the stomach a trap and the cancer parasite, if it be a parasite, strained out in the stomach? If that were true, why should not cancer of the stomach be as frequent in the lower animals as in man? In rats, cancer of the stomach is exceedingly common when the animals feed on cockroaches infested with nematodes, which cause a chronic irritation of the rat's gastric mucosa.[17] Under other conditions it is very rare in these animals.

Whenever cancer is found with great frequency in certain situations or in only one class of individuals, it appears to depend on a single cause; this is probably true of gastric cancer. Is it not possible, therefore, that there is something in the habits of civilized man, in the cooking or other preparation of his food, which acts to produce the precancerous lesion? And it is probable that there is just one cause since, if there were many causes, gastric cancer in man would have no such preponderance. Numerous factors would cause the development of cancer in other races and species equally exposed to their action. If we could but know what peculiar agency was responsible for the extraordinary frequency of cancer of the stomach, the knowledge would play a great part in the prophylaxis of cancer.

Has the question of the acidity of the stomach anything to do with the problem? The frequency of cancer in the stomach and in the large intestine, where the secretions are acid, and the absence of cancer in the small intestine, where the secretions are alkaline, is a remarkable fact. Yet this acidity of the stomach is not confined to man, but, so far as I know, the extraordinary frequency of cancer of the stomach is confined to man and to civilized man. Further investigation is needed to elucidate this most interesting problem and a possible source of information may lie in a comparative examination of the anatomy, physiology, and pathology and, especially, of the habits of those races of man and those lower animals in whom cancer of the stomach is rare.

Among the precancerous lesions of the stomach, ulcer is the most common. Yet it is a curious fact that ulcer of the duodenum is three times as frequent as of the stomach, though cancer of the duodenum is rare. True it is, however, that ulcer or some other lesion in the stomach, which is of sufficient gravity to produce symptoms not necessarily of ulcer, but symptoms of chronic irritation, existed in more than half of all those cases of cancer of the stomach in which we have been able to make a resection and in a high percentage of these an ulcer was found pathologically [23, 24] (Figs. 2 and 3). Some pathologists believe that these ulcers are carcinomatous from the beginning. If so, then the base of the ulcer should be carcinomatous (Fig. 4), but in our cases there was no cancer in the base of the ulcer; it was the overhanging margin of the ulcer which showed the cancer (Figs. 5 and 6). It is evident that precancerous lesions exist in the stomach and that these lesions, while possibly not always ulcer, give clinical evidence of their presence in the precancerous stage in at least fifty per cent. of the cases in which the history is taken with this point in view. The extraordinary muscular activity of the stomach in the condition known as pylorospasm, which may result from gall-stones, duodenal ulcer, fecal stones in the appendix, or intestinal lesions, may account for the chronic gastric irritation in some cases. It is even possible that through the influence of this great muscular contraction cells may be loosened and even forced into the underlying tissue.

The prophylaxis of cancer of the stomach consists not only in the removal of gastric ulcers, but also in the relief of all those conditions which cause gastric irritation resulting in the symptom inadequately and possibly incorrectly described as pylorospasm.

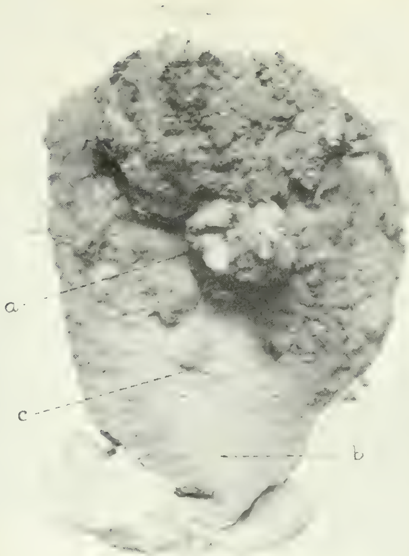
Cancer of the small intestine is extremely rare. In a series of 1882 cancers of the gastro-intestinal canal operated on in our clinic (October 1, 1897 to November 1, 1913) only 22 were cancers of the small intestine. Why is there this relative immunity of the small intestine over the stomach and the large intestine? The small intestines are the most primitive part of that system on which the maintenance of the body-functions depend. Is it possible that in the long heredity of this particular part it has developed an immunity? There is something fascinating about this theory as accounting for the lack of immunity in the stomach and the large intestine, which have relatively a short heredity. The small intestine is exceedingly primitive. That the age of any part of the body has much to do with its ability to resist disease is well known. Though it may be a figure of speech that woman was formed from the rib of man, yet it is certainly true that the ovary is descended from the testicle and that the testicle is the primitive organ found in bisexual species.[25] Tumors of the testicle are rare. As shown by Ewing,[26] all the new growths of the testicle with few exceptions are teratomas, the most primitive type of neoplasm. The ovary, on account of its short heredity, is subjected to a multitude of diseases and a large variety of tumors.

Beard's [27] theory that the immunity of the small intestine is due to the pancreatic secretion destroying whatever malignant virus may exist therein may also be mentioned. It is interesting to note, however, that the small intestines have comparatively few sources of chronic irritation and that when malignant disease of the small intestine is found it is usually due to a pre-existing lesion, such as a degenerating polyp, adenoma, or papilloma (Fig. 7).

Cancer of the appendix usually occurs in association with chronic obliterative processes [28] (Fig. 8).

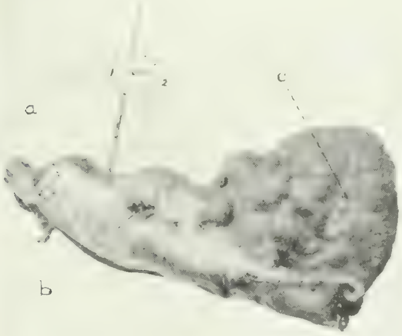
The large intestine has a much greater liability to malignant disease than the small intestine and the frequency with which cancer is found to be grafted on a source of chronic irritation can only lead to the conclusion that the soil produced by chronic irritation needs only to be activated by the cancerous virus to produce cancer in susceptible individuals. The rule is that the original lesion, by the time operation is made, has been completely obscured by the carcinomatous process,

Fig. 1.



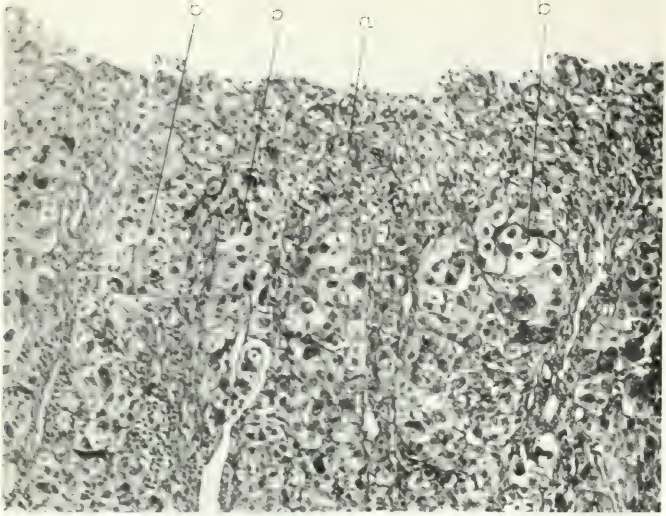
Case 23026G (H30188). Gross specimen, cancer of gall-bladder developing in mucosa long irritated by gall-stones. *a*, cancer; *b*, normal mucosa; *c*, area in which mucosa has been eroded by gall-stones, non-cancerous.

Fig. 2.



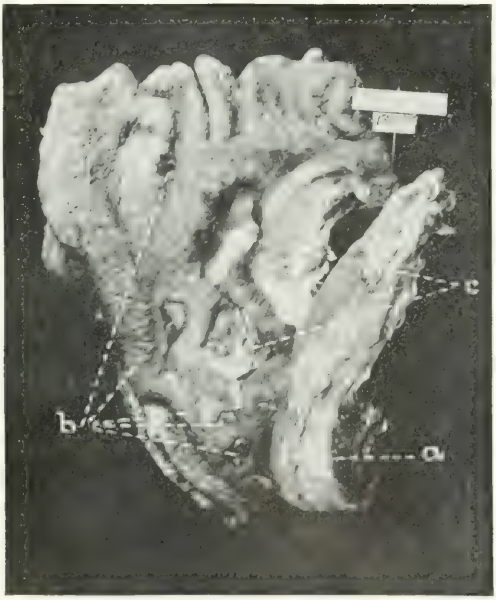
Case 5705G (H16824). Gross section through cancer of the pylorus; one of the very few cases in our series which did not show evidence of ulcer. *a*, pylorus; *b*, cancer; *c*, normal gastric mucosa.

FIG. 3.



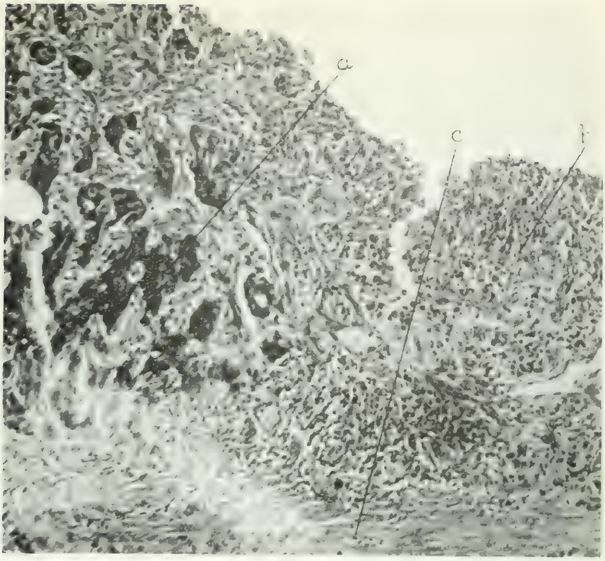
Case 80107. Microscopic section through base of ulcerated portion of gastric cancer. *a*, granulation tissue; *b*, cancer cells. In this specimen there is no pathologic evidence of ulcer preceding the cancer.

FIG. 4.



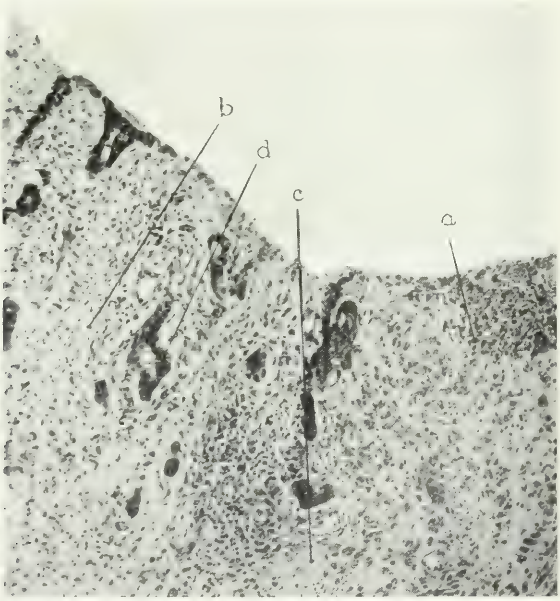
Case 6838G (H18088). Pyloric portion of stomach with multiple ulcers, two of which show areas of cancer within their borders. *a*, pylorus; *b*, chronic ulcers; *c*, ulcers with cancer developing thereon.

FIG. 5.



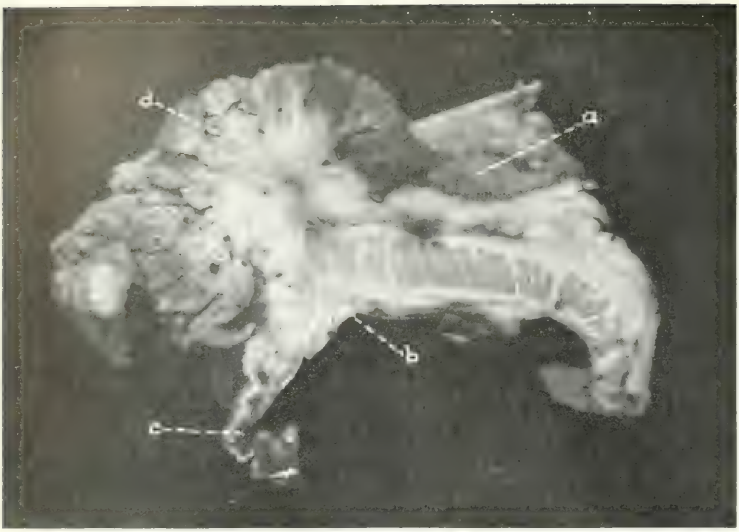
Case 77369. Microscopic section of margin of base of gastric ulcer showing cancer developing therein. *a*, granulation tissue in border of ulcer; *b*, cancer cells; *c*, scar tissue in base of ulcer. Compare with Fig. 2.

FIG. 6.



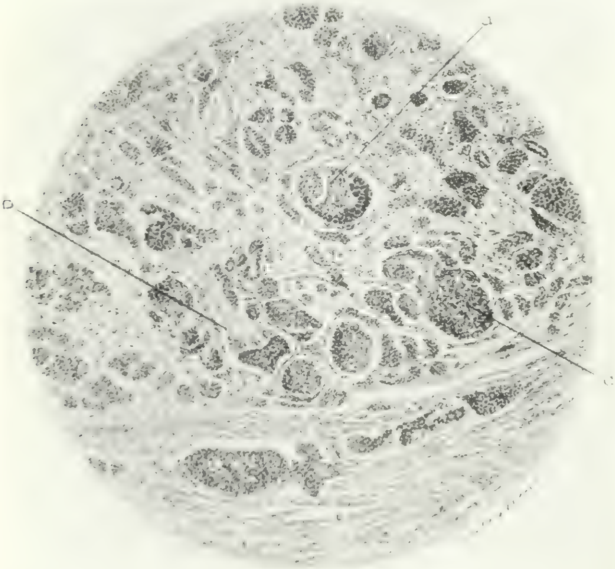
Case 1375GH. Microscopic section of margin of base of gastric ulcer showing cancer developing therein. *a*, granulation tissue in base of ulcer; *b*, scar tissue in border of ulcer *c*, scar tissue in base of ulcer; *d*, cancer cells.

Fig. 7.



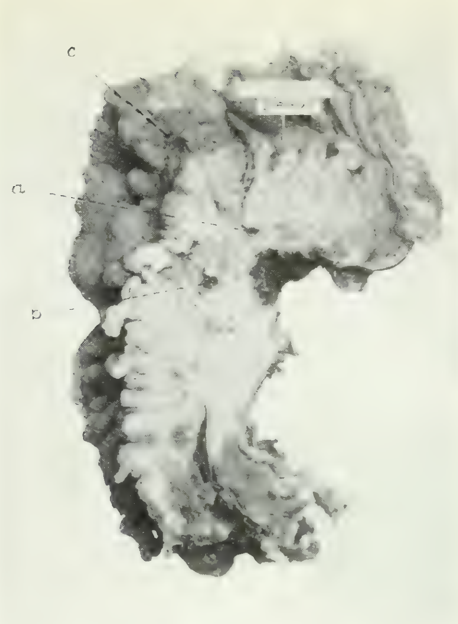
Case 61097. Gross section through pylorus showing cancer developing on a papilloma which springs from the duodenal side of the pylorus. *a*, gastric mucosa; *b*, pylorus; *c*, duodenum; *d*, cancer.

Fig. 8.



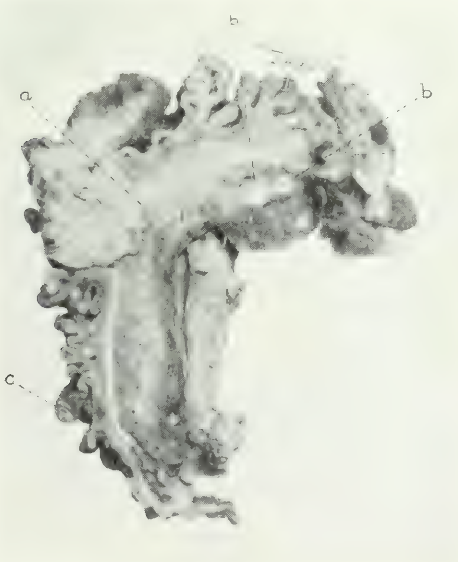
Case 25398 (H31025). Microscopic section through cancer in the tip of an appendix, the mucosa of which apparently had been obliterated by chronic inflammation. *a*, cancer cells; *b*, connective tissue.

FIG. 9



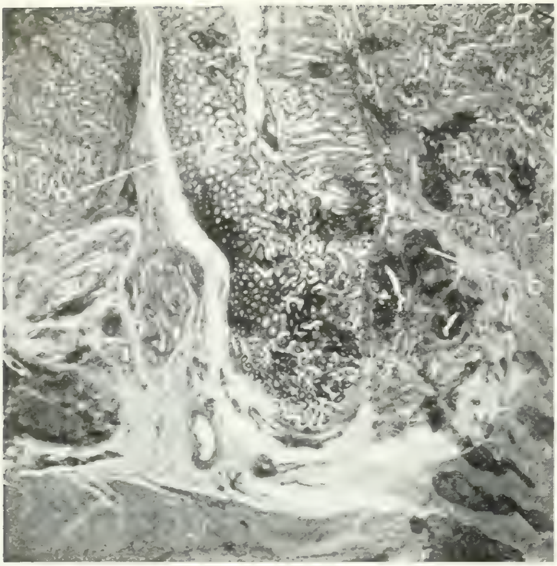
Case 18633G (H28835). Gross longitudinal section through specimen removed from sigmoid showing chronic diverticulitis with cancer developing thereon. *a* and *b*, diverticula; *c*, surface of cancer.

FIG. 10.



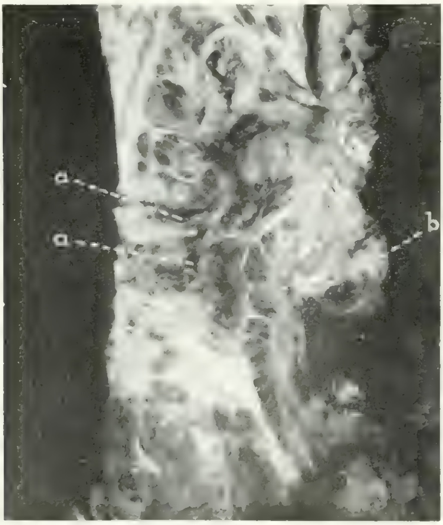
Case 18633G (H28835). Gross longitudinal section through same specimen as shown in Fig. 9 at level marked *c*, showing cancerous areas. *a*, cancerous mass surrounding almost completely obliterated diverticulum; *b*,*b*, metastatic cancer of lymph-glands; *c*, normal mucosa.

FIG. 11.



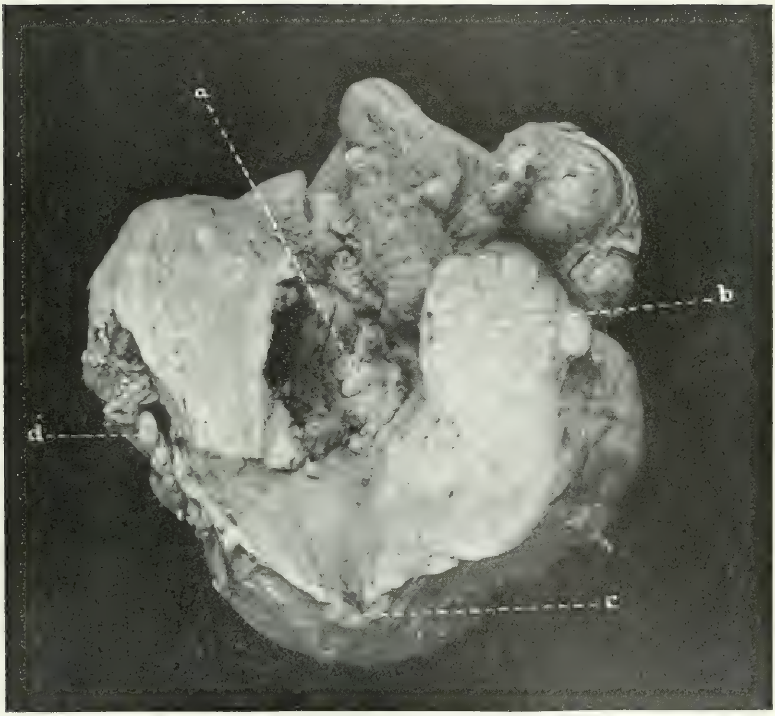
Case 9406G. Microscopic section longitudinally through a diverticulum of the sigmoid in the wall of which cancer has developed. *a*, hyperplastic mucosa; *b*, cancer.

FIG. 12.



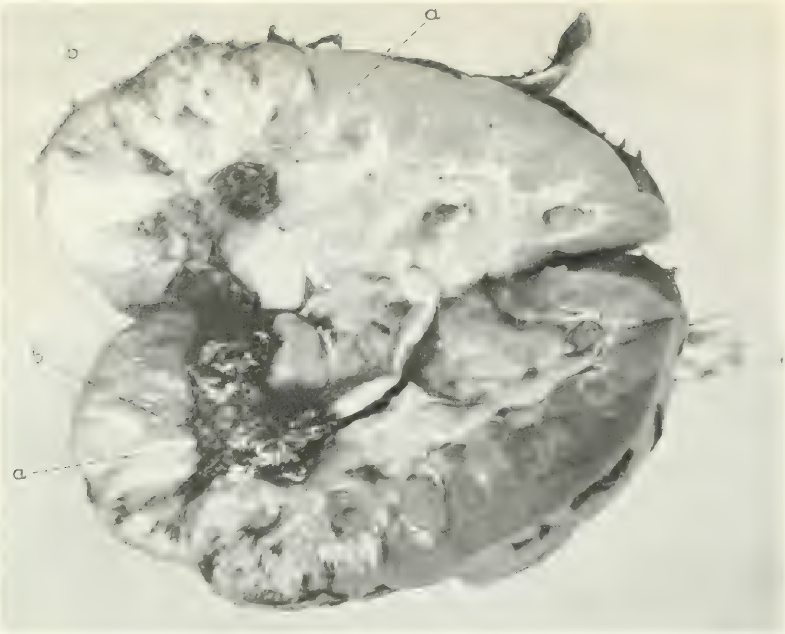
Case 37405. Gross longitudinal section through the wall of rectum showing diverticula around which cancer has developed. *a*,*a*, diverticula; *b*, surface of cancer which, starting around the diverticula, has extended to the mucosa.

Fig. 13.



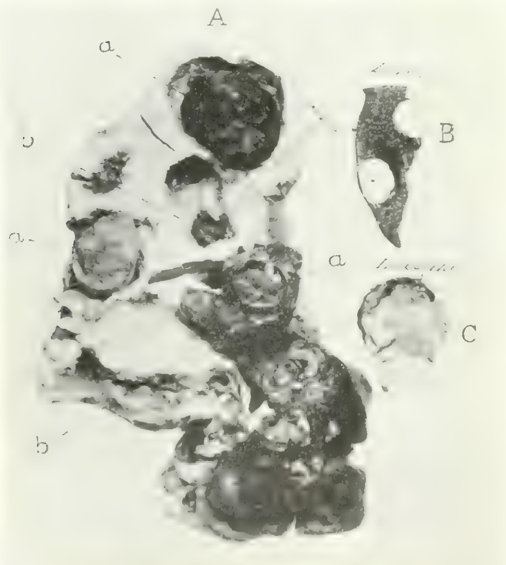
Case 46337. Uterus opened to show cancer beginning at point where endometrium has been chronically irritated by a fibroid in opposite wall of uterus. *a*, cancer; *b*, fibroid; *c*, cervix; *d*, right tube.

Fig. 14.



Case 83255. Gross section through kidney showing cancer developing in tissue chronically irritated by stones. *a,a*, stones; *b,b*, cancerous areas.

Fig. 15.



Case 30265. *A*, gross section through kidney removed at operation, showing cancer developing in tissue chronically irritated by large stones; *a,a*, stones; *b,b*, cancerous tissue; *B*, metastatic cancer in liver of same case (autopsy); *C*, metastatic cancer in wall of intestines from the same case (autopsy).

but in all our early operations lesions of a precancerous nature were found. Especially is this true of the sigmoid and rectum, where, in 37 cases of diverticulitis, the irritation of the little hard balls of fecal material in the ends of these pouches has given rise to malignant disease in twenty per cent. of the total [29,30,31,32] (Figs. 9, 10, 11 and 12). It is probable that the supposed long duration of cancer of the large intestine, cases of which have been reported, were in reality tumefactions from chronic diverticulitis followed later by malignant change.

We must not lose sight of the fact that a changing physiology of an organ may be of itself a source of weakness and possibly act as a cause of local irritation. Such a change is undoubtedly going on in the proximal half of the large intestine. Plant life is parasitic on the inorganic world and depends on chlorophyl for its potency. We should know more about chlorophyl upon which in the last analysis life depends. Animal life is parasitic upon plant life, man on both plant and animal and increasing rapidly the flesh intake. Within the last 100 years, four times as much meat is taken as before that time.[33] If flesh foods are not fully broken up, decomposition results and active poisons are thrown into an organ not intended for their reception and which has not had time to adapt itself to the new function.

The development of malignant disease in the uterus and kidney shows the same relation to chronic irritation. Cancer of the cervix occurs fifteen times as frequently as cancer of the body of the uterus, but in myomatous disease cancer of the body of the uterus is found five times as frequently as cancer of the cervix, the chronic irritation of the uterine tumors increasing the incidence 75 times (Fig. 13).

Of all the cases of epithelial cancer of the kidney which came to operation in our clinic not less than 50 per cent. were demonstrably superimposed on extensive renal calculus formation (Figs. 14 and 15).

In conclusion, I would again call attention to the fact that pre-existing lesions play the most important part of the known factors which surround the development of cancer, that such precancerous lesions are produced by some habit or life condition which causes chronic irritation, that where cancer in the human is frequent a close study of the habits of civilized man as contrasted with primitive races and lower animals, where similar lesions are conspicuously rare, may be of value, and finally, that the prophylaxis of cancer depends, first, on a change in those cancer-producing habits and, second, on the early removal of all precancerous lesions and sources of chronic irritation.

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SYSTEMIC BLASTOMYCOSIS.*

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THE knowledge of the fact that yeasts may act as pathogenic agents dates from the year 1890 when Grohe [3] reported to the Greifswald Medical Society the result of experiments made by him with mould and yeast fungi injected into the blood or peritoneum of animals. These animals usually died shortly after injection. In 1892 Popoff [4] employed ordinary commercial compressed yeast which was cut into small pieces, dried, ground to a powder, strained through a towel and injected into the blood-vessels, beneath the skin, and into the thoracic cavity of dogs. The animals usually died within a few hours or days, with septic phenomena. Popoff often noted the appearance of nodules, resembling tubercles, in the kidneys, spleen and lungs. Microscopically these nodules were found to contain yeast cells and starch granules. The above named experiments were made with impure material and were therefore hardly considered convincing.

The first article carrying fair conviction regarding the problem of pathogenic yeast was published by Raum [5] who injected several kinds of yeasts into rabbits, apparently observing localization and growth of these microörganisms in the animal body.

In 1893 Tokishige,[6] Professor at the Tokio Veterinary Academy, described an endemic disease of horses in Japan in which a fission fungus was found to be so abundant that, after prolonged microscopic examination, he believed himself justified in regarding it as the cause of the disease. This report attracted but little attention even from the veterinarians.

Busse [7] and Buschke,[8] in 1894, reported in detail a case which came under their observation in the surgical clinic at Greifswald. Shortly thereafter, and independently, Gilchrist[9] reported a case of skin disease, supposed to be due to yeasts, in man. However, in view of the fact that he made no cultures, his observation is hardly to be regarded as convincing. Busse would accordingly seem to be entitled to the credit of having been the first to make clear observations.

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* Read before the American Surgical Association, April 9, 1914.

In a general way it may be said that the disease in animals, appearing in epidemics, is relatively benign in character. Many animals get well, while the majority of the fatal cases seem to succumb to exhaustion through the superficial distribution of the process rather than through its penetrating to the viscera. Buschke considers the avenue of entrance as ordinarily occurring through the skin, whence, in man, it is carried into the interior of the body. As far as he is able to ascertain, the distribution takes place by way of the lymph-channels through which the fungi reach the lymph-glands. In the rarer cases of retrogression of the local disease a subsidence of the pathological process can also be noted in the lymph-glands. For further and extensive account of the pathological process the reader is referred to this valuable and instructive article by Buschke.

In systemic blastomycosis, as well as in the cutaneous form, the most common change is represented by a simple mycosis. Proliferation processes may develop in the affected tissue much as they do in the so-called infectious granulomata.

An instructive communication was made in 1910 by Franchetti and Cazzaniga,[18] who believed themselves justified, on the basis of cases described in literature, of personal experimentation and the experiments of others, in coming to the conclusion that yeast microörganisms undoubtedly possess pathogenic properties, although this particular family of fungi is very large and the group is still obscure.

As regards the clinical course of infectious blastomycosis, experimental findings serve to confirm the results of clinical observations. The course is usually slow, anæmia is present, there is generally progressive emaciation. Albuminuria is frequent and the end is almost always fatal in the severe general infections and in the forms with localization in the nervous system. Any or practically all of the tissues of the body may be affected.

Two cases of systemic blastomycosis, both fatal, have come under my observation. The first was a man of forty-four years who gave the following history: He suffered from pneumonia at 19 years of age, while at the age of 23 years he had a bronchial cough which lasted for one year. Two years later this cough returned and continued for one year when he went to the Adirondacks, living there for about six months. He had had no subsequent chest trouble. At 32 years of age he noticed two small, soft lumps in the lower part of the neck, one above each collar-bone. These gradually enlarged and were removed 15 months later. No microscopical examination seems to have been made, the sinuses healed slowly.

In 1902 two small, hard nodules, each about the size of a pea, appeared in the lower part of the neck in the median line and were removed. One year later another nodule was removed. At this time the general health was considerably below par.

In the latter part of 1903 he went to South Carolina where the general condition tended to improve. At about this time another lump appeared but it gradually subsided. This lump re-appeared six months later and was taken out. In 1906, while in Europe, he suffered attacks of indigestion and jaundice, these attacks lasting two or three months. From this time, 1906, until the autumn of 1910, his general condition remained fairly good. He spent the winter of 1910–11 in California and during these winter months many lumps appeared below the lower jaw on each side. He passed the spring of 1911 in Arizona, coming to Denver in June, at which time I found the entire neck below the lower jaw, on each side, filled with hardish lumps and presenting multiple sinuses. The general condition was much impaired. I cleared the neck thoroughly on each side, but through some unfortunate error, possibly owing to the fact that I was leaving town, the tissues were not histologically examined. My own clinical diagnosis was tuberculosis. Two or three weeks after this operation upon the neck small, soft lumps appeared on the abdomen and thighs beneath the skin. These were opened, discharging pus and healing rather slowly.

In August, 1911, evidence of disease of the two last dorsal vertebræ was found, both on examination and by the X-ray.

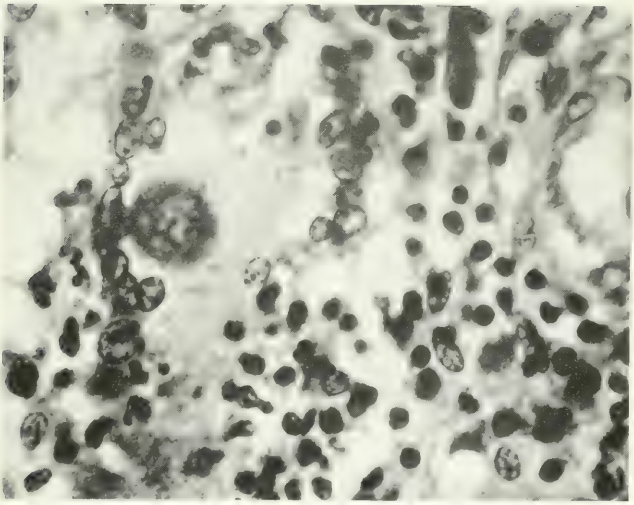
In October, 1911, on my return from Europe, I opened a number of moderate sized abscesses on the back, thighs, and right hand. Cultures from these abscesses gave pure blastomycosis. From time to time other abscesses appeared in different parts of the body and on being opened showed, on culture, the same micro-organism. Thoracic and abdominal symptoms came on and from August, 1911, the patient's health gradually failed. Management rested on general tonics, the best possible attention to the general health, and on the occasional employment of potassium iodide and cupric sulphate. These latter drugs were not well borne and he died from exhaustion April 20, 1912. Autopsy was made by Dr. Ross C. Whitman, Professor of Pathology in the University of Colorado. Dr. Whitman's report is as follows:

Pathological Diagnosis.—Sinuses angle of left jaw, right side of neck above clavicle, extensor surface right thumb and on back. Six openings at various levels either side of spinal column, and one on inner aspect left thigh. Emaciation. Multiple miliary abscesses of liver; 2 miliary abscesses spleen; caries thoracic spine; iliopsoas abscess (moderate size, not prominent); miliary abscess pelvis left kidney; nephritis (?); acute, fibrinous, left-sided pleurisy with exudate. Destruction lower lobe left lung.

Dr. Whitman further reports: "The lesions found macroscopically in bone, liver, pleura and submaxillary lymph-nodes, as well as the microscopic lesions found in the spleen, are everywhere essentially alike, the differences being apparently due in part to the stage of development of the individual lesion, and in part to the physical conditions, as in the pleura, where the character of the serous membrane and friction have somewhat modified the picture. The main features of the disease process can be reconstructed in considerable detail.

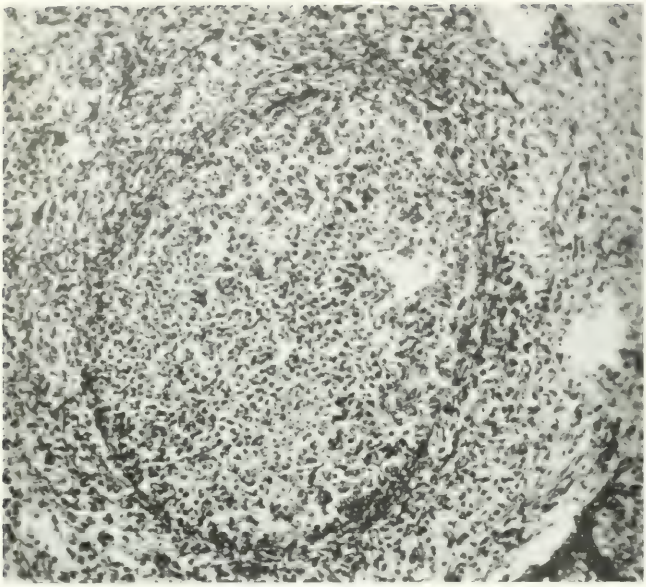
"The organism lodges first in a small vessel or capillary. The endothelial cells proliferate, becoming larger and plumper, and separate from the wall. Later they may fuse about the organism to form a typical giant-cell of the Langhans type. The vessel is occluded, and the vessel wall disappears, leaving a collection of endothelial cells. This enlarges, encroaching on the surrounding parenchyma, which disappears, leaving a supporting connective tissue stroma and capsule. The connective tissue also increases to some extent, and may organize the lesion, replacing it by scar tissue. In the earlier stages of the lesion there is more or less

FIG. 1.



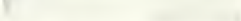
Intravascular formation of giant-cell about a blastomyces. Zeiss apo. obj. 2 mm. oil immersion, comp. oc. No. 8.

Fig. 2.



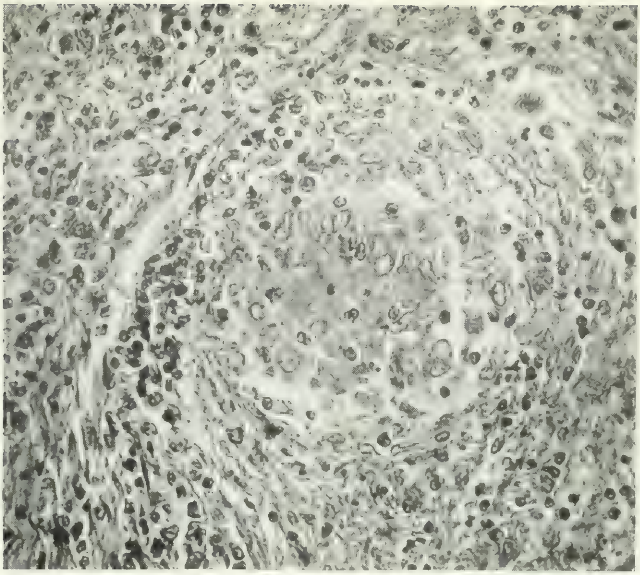
Small granuloma from pleura, consisting of a collection of endothelial leucocytes (endothelioid cells). The wall in this case consists of fibrin. Zeiss apo. obj. 16 mm. without ocular.

Fig. 3.



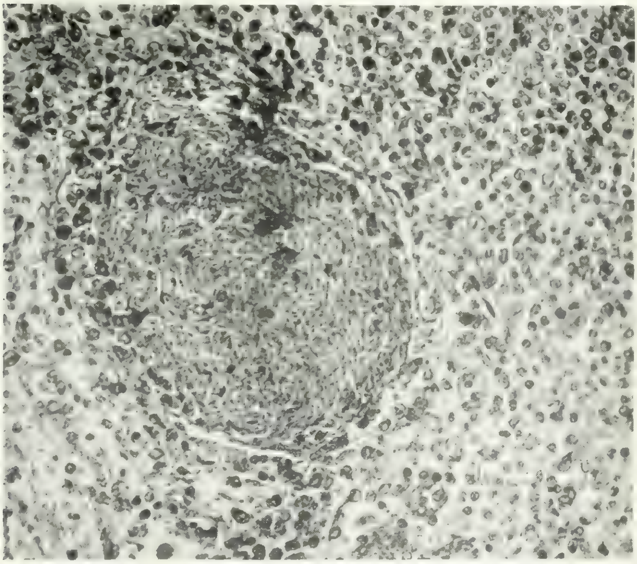
Blastomyces showing endosporulation (ascus formation). Zeiss apo. obj. [illegible] mm., comp. oc. No. 4.

Fig. 4.



Small lesion from spleen. Group of endothelial cells, with beginning necrobiosis and infiltration of polymorphonuclear leucocytes. Magnification as in Fig. 3.

Fig. 5.



Lesion from spleen showing early fibrosis. Magnification as above.

infiltration by leucocytes among which plasma cells and eosinophilic myelocytes are a striking feature, which serves at once to distinguish the process from tuberculosis. Somewhat later the cells of the lesion undergo a wide-spread and uniform coagulation necrosis, similar to the type commonly met with in rapidly growing malignant tumors, and differing from caseation in the fact that the structure of the cells can be recognized for some time after necrosis has taken place. Lesions as large as 1–2 cm. in diameter may consist of a capsule surrounded by a narrow zone of leucocytes and small daughter lesions, and containing a pasty mass of necrotic cells with little or no living tissue. Ultimately, the dead tissue is extensively infiltrated by polymorphonuclear neutrophiles, the disintegration of which, with the resulting liberation of proteolytic ferments, is doubtless responsible for the liquefaction which occurs.

"The process in the pleura is modified by the pouring out of a profuse fibrinous exudate in which abundant pus cells are found. Apparently there has been no tendency to walling off, the exudate having spread uniformly over the entire serous membrane.

"The organism is found fairly abundantly in all the lesions. It was described in some detail by myself in a paper published last summer (*Journal Infectious Diseases,* vol. xiii, p. 85, 1914). It will suffice here to call attention to the fact that unquestionable budding forms are not found. Multiplication seems to take place only by 'endosporulation,' which in the paper above mentioned is interpreted as ascus formation. I can but think that the original condition in this case was blastomycosis."

My second case was observed some years ago and in its main features followed the course of the one just narrated, excepting that the original focus was a nodule at the back of the left hand, which nodule had undergone suppuration and curetting some three years before the patient came under my observation. The case terminated fatally with thoracic, abdominal and joint lesions. The histology and bacteriology were carefully studied and reported upon by Dr. J. A. Wilder, at that time Professor of Pathology in the University of Denver.

The literature upon this subject is abundant and need not be reproduced here. The central thought in my mind is that the systemic form of blastomycosis is almost invariably fatal and that this grave condition generally begins in a small local focus. I believe that such local focus or foci should be very widely excised as early as possible, in order to attempt to forestall dissemination.

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[9] Gilchrist: Johns Hopkins Hospital Reports, Baltimore, 1896.
[10] Brewer and Wood: ANNALS OF SURGERY, December, 1908.
[11] Baum: Buffalo Medical Journal, June, 1909.
[12] Whitman: Journal of Infectious Diseases, vol. xiii, July, 1913.
[13] Christenson and Hektoen: Journal American Medical Association, July 28, 1906.
[14] Walker and Montgomery: Journal American Medical Association, April 5, 1902.
[15] Alexander: Diag. Ther. f. prak. Aerzte, 1907, p. 763.
[16] Stelwagen: Treatise on Diseases of the Skin. 7th edition, 1914.
[17] Lexer-Bevan: General Surgery.
[18] Franchetti and Cazzaniga: La Sper., vol. 64, 1910, p. 449.

THE VALUE OF GLUZINSKI'S TEST IN THE DIAGNOSIS OF GASTRIC ULCER.*

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Professor of Clinical Surgery at the University of Christiania.

THE chemical analysis of the stomach contents after test-meals is of relative value but not pathognomonic.[1] Many surgeons of large experience are even of the opinion that the chemical analysis takes only a very subsidiary place in the diagnosis of diseases of the stomach.

It therefore created considerable attention, when Kocher at the German surgical congress, 1912, recommended Gluzinski's reaction as a means of making the differential diagnosis between ulcer and cancer, thus bringing to the fore a half forgotten method described for the first time some ten years ago.

Gluzinski[2] proceeds from the supposition, which is now going to be accepted as a fact, that a great number of cases of cancer of the stomach develop upon the basis of an ulcer.

His working hypothesis is as follows:

An *ulcer* situated in the pyloric portion being the cause of retention is, as a rule, accompanied by *hyperacidity* of the contents, while a *cancer* is attended by a mucous (or atrophic) catarrh which causes a *disappearance of the free hydrochloric acid.*

During the transformation of an ulcer into a cancer there will yet be found free hydrochloric acid up to a certain stage of the disease. But during the progress of the mucous catarrh there will occur a *secretory insufficiency* which may be demonstrated by giving two test-meals, one meal following immediately upon the other.

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* Read before the American Surgical Association, April, 1914.

[1] W. J. Mayo: Operative Treatment of Cancer of the Stomach. Journal of the Amer. Med. Assoc., Bd. 61, No. 8.

[2] Gluzinski: Ein Beitrag zur Fruhdiagnose des Magenkrebses. Mitt. aus. d. Grenzgeb. d. Med. u. Chir., Bd. x, 1902, p. 1.

Gluzinski examines the gastric contents (1) recovered from the fasting patient; (2) after administering a test breakfast consisting of the white of a boiled egg and 200 c.c. of water which is recovered after three-quarters of an hour; (3) after a test dinner consisting of a beefsteak and 250 c.c. of water which is recovered after three and three-quarters hours.

The stomach is washed out before and after the first meal and the second meal is given immediately after the second washing.

In *ulcer* both the breakfast as well as the dinner give distinct reaction of free HCl.

In beginning cancer the *first meal* also will give distinct reaction of free HCl, while the *second one* will show only a slight trace, or free HCl will be altogether absent.

He diagnosed a beginning cancer in 3 cases, the diagnosis being verified at subsequent operation.

This method is being utilized by Kocher who has somewhat modified it and enlarged upon its applicability.

By determining the percentage of free HCl in the two meals he has found that the free acid is present in larger quantities after the second meal in *ulcer,* while in *cancer* this meal (the test dinner) shows the lowest percentage of hydrochloric acid.[3]

The preëminence of this method is that the diagnosis of ulcer or cancer is *not* based on the *absolute* value of free HCl in the gastric contents, but on the *increase* or *decrease* in the amount of free acid in the recovered meals.

But, moreover, he believes that the method may be used also in the *absence* of free hydrochloric acid in which case the *total acidity* shows the same proportions, always supposing that there is no lactic acid present.

In 30 cases of ulcer tested according to this modified

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[3] The cases tested in this way at the Clinic Berne are described by Fonio: Ueber die Resultate der Untersuchungs methode nach Gluzinski u. s. w. Deutsche Zeitschr. f. Chir., Bd. 116.

Gluzinski method, the diagnosis was verified at operation in 27 cases, in 2 cases the result was uncertain and in 1 case there was found carcinomatous degeneration of an ulcer, although the test indicated the presence of a simple ulcer. (Borghis or Petit.)

The results obtained by Kocher are to some extent being contested by Dr. Rusca,[4] Berne, while Kleinschmidt[5] and Hohlbaum,[6] both of Leipzig, speak very approvingly of the value of the test.

Before describing our own experiences I must state that both Gluzinski himself as well as Kocher and those who later have adopted the method most emphatically take reservations against the belief that they are accepting the results of this chemical reaction as decisive for the diagnosis. It is nothing but a symptom which is to be judged in conjunction with the other symptoms and with the history of the case.

As to *the theoretic foundation* for the method this seems to be pretty well laid.

My first assistant, Dr. Backer-Grondahl,[7] has made some examinations upon an otherwise healthy person with a gastric fistula established because of a cicatricial stricture of the œsophagus.

Grondahl administered Gluzinski's test-meals through the fistula and the results of his examinations are in accordance with those already known from the experiments of Pavlow upon animals and from the experiments by Hornberg upon the case of a patient with gastric fistula.

There occurs reflexly an increased production of gastric juice when the gastric mucous membrane receives an increased food irritation.

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[4] F. Rusca: Beitrag zur Magendiagnostic, etc. Correspondenz-Blatt f. Schweizer Aerzte, 1913, No. 46, p. 1498.

[5] Kleinschmidt: Uberblick uber das Magenmaterial der Leipziger chir. Universitat klinik.

[6] Hohlbaum: Ergebnisse der Salomonschen und der Gluzinskischen Probe, etc. Centralblatt f. chir., 1913, No. 35.

[7] N. Backer-Grondahl: Forelobige resultater med. Gluzinski's undersokelsesmethode, etc. Nordisk Tidsskr. f. Terapi, xi, Aarg 11 H, 1913.

It has been shown that not only is the amount of gastric juice increased but also is the concentration of the hydrochloric acid greater as the irritation increases.

At the surgical clinic of Christiania University we have employed the Gluzinski method since October, 1912, in the examination of 86 cases, to wit: 25 cases of gastric ulcer, 9 cases of duodenal ulcer, 21 cases of cancer of the stomach, 15 cases of gastro-enteroptosis, 11 cases of chronic appendicitis and 5 cases of gall-stones.

The diagnosis is in all of the cases controlled by operation, some of the ptosis cases only by röntgenogram.

Of our *cancer* cases two only had free hydrochloric acid and in both the test agreed with the results as obtained by Gluzinski, to wit: a *decreasing* amount of free hydrochloric acid in the test dinner (Fig. 1).

In those cases of cancer of the stomach where free hydrochloric acid was absent we have found *no regular decrease of the total acidity;* we are so far unable to support the statement made by Fonio, that the method may be used in such cases.

In fact, the total acidity was *increasing* in the second test-meal in about 50 per cent. of the cases.

During our further examinations we soon arrived at the conclusion, however, that the percentage of free HCl may *decrease* in the second meal *also in diseased conditions of the gastro-intestinal canal other than cancer of the stomach.*

We found the free hydrochloric acid values to be diminishing in the test dinner in cases of *gastro-enteroptosis.*

But not in all of them—the phenomenon was not dependent upon the anatomical position of the gastro-intestinal canal in itself—we found it in cases where chronic obstruction appeared simultaneously with gastro-enteroptosis (Fig. 2). Cases of gastro-enteroptosis without obstruction are shown on Fig. 3.

In the first of those cases we made resection of the pylorus because we imagined that we felt a hard little knot in the wall of the stomach. But microscopical examination of the

FIG. 1.

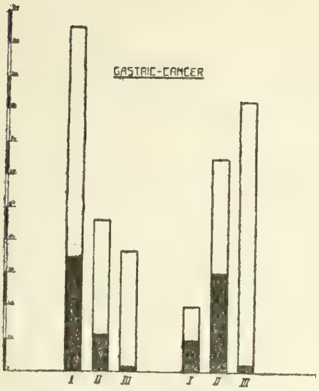


FIG. 2.

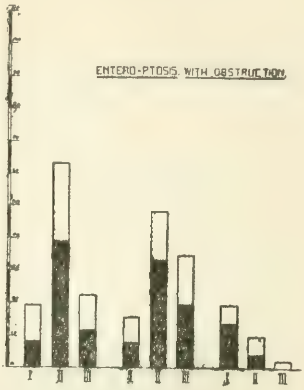


FIG. 3.

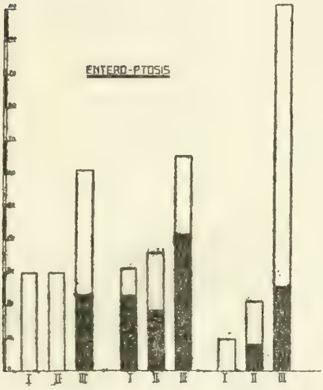


FIG. 4.

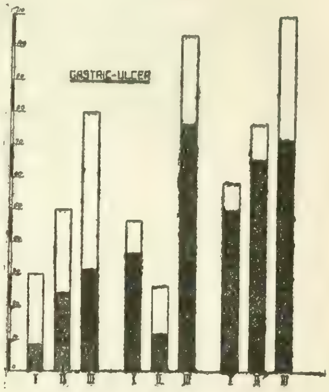
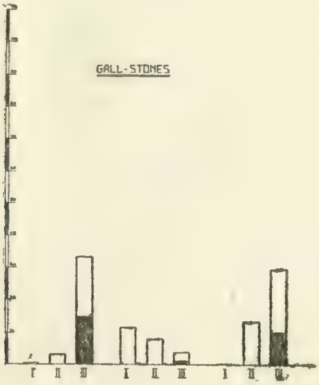


FIG. 5.



Diagrams of acid-values in the gastric contents. I, recovered from the fasting patient; II, recovered after the test breakfast; III, recovered after the test dinner. Black: free hydrochloric acid; white: total acidity.

resected piece did not show any traces of cancerous degeneration.

Gluzinski's test is a test of function, which demonstrates the failing ability of the mucous membrane to secrete hydrochloric acid.

But this failing ability may be found also in other conditions than those prevailing during the development of a cancer. Further experience will show which are those conditions.

It only confirms the statement made by Dr. W. Mayo that the " early diagnosis of cancer does not depend on any sign or symptom due to the cancer itself."

By examining 25 cases of *gastric ulcer* we found that all of them but one [8] reacted in the manner described by Gluzinski and Kocher as being characteristic of ulcers of the stomach, to wit: with a decided increase in the percentage of the hydrochloric acid and of the total acidity.

After ingestion of the beefsteak rather high values of hydrochloric acid are obtained, and this is possibly most pronounced in those cases in which the dyspeptic symptoms are most severe (see Fig. 4).

So strongly pronounced and so apparent has this phenomenon been in our cases that it possibly may be used as a differential symptom in the diagnosis between ulcer and other diseased conditions of the gastro-intestinal tract attended by dyspepsia.

Thus in two cases referred to us from the medical ward with the diagnosis of callous ulcer—in one of them this was even the Röntgen diagnosis—we found hypo-acidity with very little increase after the test dinner.

In none of them was ulcer found at the operation. A few adhesions between the duodenum and the gall-bladder were separated and both patients have later informed us that they have got rid of their previous very severe symptoms after the operation.

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[8] Male aged forty-four years. The hydrochloric acid percentage after the beef-meal decreased a little, while the total acidity increased. The difference was, however, slight and at the operation it could not be decided whether a cancer positively was developing or not, as the stomach was imbedded in a mass of firm perigastric adhesions.

On Fig. 5 I have given a graphic diagram of the acid values found in some cases of gall-stones examined according to Gluzinski's test.

By comparing the columns with those belonging to ulcer cases (Fig. 4) the difference will seem striking.

In our 9 examined cases of duodenal ulcer the hydrochloric acid values were not as high as in gastric ulcer and the increase in the percentage of free acid in the second meal was moderate in 7 cases, while it was relatively great in two cases.

But the difference in this respect between gastric and duodenal ulcer is not great enough to be made use of as a means of differential diagnosis.

We have tried to differentiate between various forms of appendicular dyspepsia, but have as yet obtained no definite results.

In our opinion Gluzinski's method is better than any other for testing the secretorial function of the stomach.

Thus, in cases where free hydrochloric acid apparently is absent and not to be found after an Ewald's test breakfast, the second meal in some cases will produce a gastric juice containing hydrochloric acid.

As a whole, we have found Gluzinski's test reliable. It ought to be used as a help to make the differential diagnosis in doubtful cases of gastric ulcer.

A METHOD OF SUBTOTAL GASTRECTOMY.*

BY FRANCIS T. STEWART, M.D.,

OF PHILADELPHIA,

Professor of Clinical Surgery in Jefferson Medical College.

I AM emboldened to bring the operation described in this paper to the attention of the Association because of the difficulties that are sometimes experienced, after partial removal of the stomach, in joining the first segment of the jejunum with the posterior wall of the gastric stump, and because of the obvious disadvantages of the simpler but more dangerous anterior, antecolic, long-loop gastro-enterostomy. Billroth's first method (end-to-end anastomosis between the stomach and the duodenum) and Kocher's implantation of the open end of the duodenum into the posterior wall of the stomach are, I imagine, rarely considered at the present time, owing to the great tension exerted on the anastomotic sutures, especially if one removes as much stomach as is demanded in the modern operation for carcinoma of the pylorus.

The method of subtotal gastrectomy that I desire to submit for criticism consists in removing the diseased segment of stomach from left to right, after performing an end-to-side anastomosis between the lower portion of the incision, which amputates the stomach and the upper part of the jejunum, the operation being so conducted that the suturing necessary to unite the stomach to the intestine is completed before either viscus is opened.

The gastric artery is doubly ligated at the upper end of the proposed line of section of the stomach, and divided between the ligatures. The gastrohepatic omentum is tied in sections and severed. The left gastro-epiploic artery is ligated about one-half inch on each side of the lower end of the proposed line of section of the stomach, and the segment of artery between the ligatures excised. The gastrocolic omentum is tied

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* Read before the American Surgical Association, April 9, 1914.

and cut, from a point about two inches to the cardiac side of the selected line of gastric amputation to the duodenum. The transverse mesocolon is drawn taut, without pulling the colon from the abdominal cavity, and a hole torn in this membrane, from the upper side, within the arc of the midcolic artery. The upper end of the jejunum immediately bulges into this opening and is drawn into the lesser peritoneal cavity. A suture is passed through the greater curvature of the stomach, midway between the ligatures on the left gastro-epiploic artery, and through the antimesenteric border of the jejunum, at a point about five or six inches below the origin of the jejunum, the distance varying according to the degree of dilatation of the stomach. By pulling upward on this suture the posterior wall of the stomach and the upper segment of the jejunum are brought in contact. A suture uniting the posterior wall of the stomach to the intestine is inserted about three inches above the original suture, and a third suture is passed through the posterior wall of the stomach alone, an inch or more above the second suture (Fig. 1), both of these sutures being on the line through which the stomach is to be amputated. Two sutures are now placed in the anterior wall of the stomach, at points corresponding to the upper sutures in the posterior wall (Fig. 2). The point at which each anterior suture is to be inserted may be determined easily by grasping the stomach with the left hand in such a way that the index finger presses the point of insertion on the posterior wall up against the corresponding point on the anterior wall, which point is marked by the thumb. Suture *A* is now drawn upward and to the right (*i.e.,* toward the patient's right shoulder), sutures *B* and *D* downward and to the left (*i.e.,* toward the patient's left hip) and tied together, sutures *C* and *E* likewise downward and to the left and tied together (Figs. 3 and 4). The upper segment of the jejunum is thus surrounded by the stomach, the anterior wall of which lies against the right side of the bowel, the posterior wall against the left side of the bowel. Between sutures *B, D* and sutures *C, E* the anterior and the posterior walls of the stomach are in contact, which contact is made permanent by the introduction of a seroserous suture of celluloid thread, which suture is continued from *B, D* to *A,* uniting the anterior wall of the stomach to the bowel, and from *A* back to *B, D,* uniting the posterior wall of the stomach to the bowel (Fig. 4). This seroserous suture is overlaid by a through-and-through catgut suture, and sutures *B* and *D* cut off short. The greater curvature of the stomach is grasped with forceps about one-half inch from *A* (Fig. 5), and the lesser peritoneal cavity filled with gauze. The portion of the anti-mesenteric border of the intestine exposed between the rows of sutures is excised, and an incision made in the stomach close to the suture line, beginning at *G,* passing between *A* and *F,* and ending at *H* (Fig. 5). After ligating any vessels which have not been caught by the sutures, thread *A* is cut and the stomach allowed to straighten itself (Fig. 6). A clamp is placed across the stomach to the pyloric side of the line of section, and the amputation completed after approximating the anterior and the posterior walls of the stomach, between *J* and *K* (Fig. 6), by several through-and-through sutures of catgut, which sutures are buried by an inversion seroserous suture of celluloid thread. It is well, but not essential, to insert the uppermost inversion suture before completing the amputation of the stomach, since by pulling on this suture the raw edges, which are already inverted at the lower end (*J,* Fig. 6), recede between the serous coats, which can then be rapidly sutured (Fig. 7). The pyloric segment of the stomach is drawn from the abdominal cavity and turned over on the patient's right hypochondrium, the superior pyloric and the gastroduodenal arteries secured above and behind the pylorus, the duodenum severed between ligatures, and the duodenal stump inverted. The edges of the rent in the transverse mesocolon may be attached to the jejunum or, if there is much gastrectasia, to the stomach.

The operation just described may be performed in any case of gastrectomy in which posterior gastro-enterostomy is applicable, and perhaps in some in which, owing to the small size of the gastric stump, posterior gastro-enterostomy would

FIG. 1.

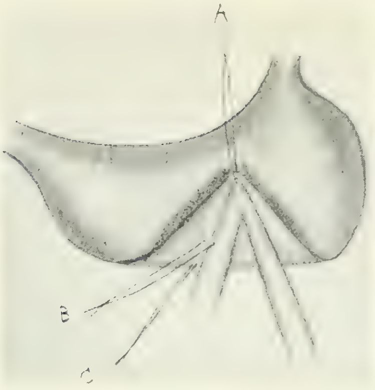
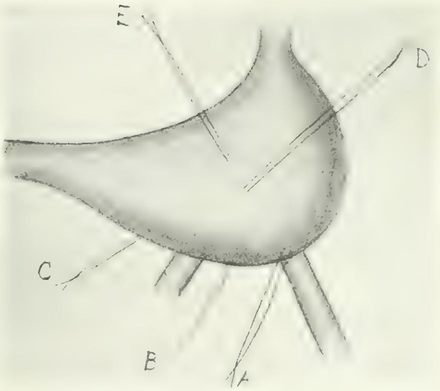


FIG. 2.



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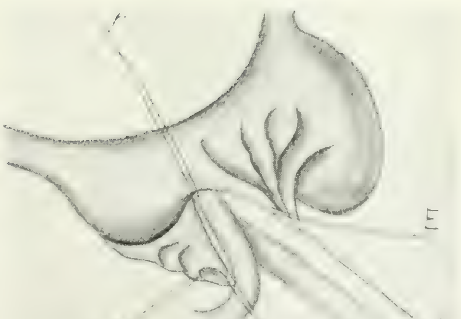

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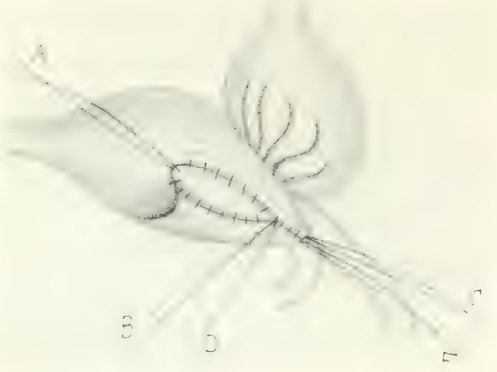

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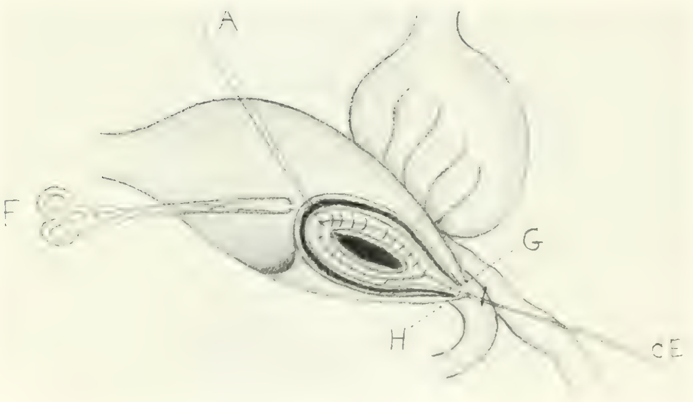


Fig. 6.

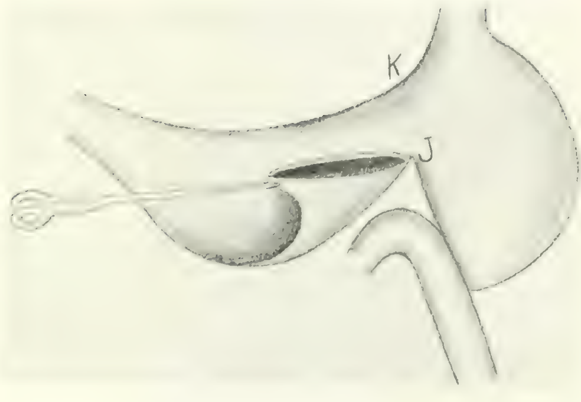
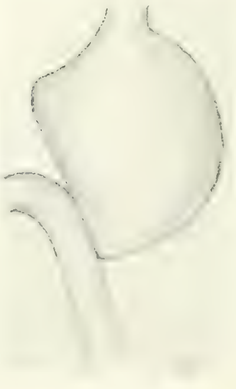


Fig. 7.



be injudicious. With equal practice in the two operations the newer one should be less difficult and more rapid; there is less cutting to be done, consequently less suturing; the lower part of the incision for amputating the stomach serves at the same time for the anastomotic opening. In the newer method the anastomotic opening is at the lowest part of the stomach, and all of the anastomotic sutures and a portion of the sutures which close the stomach above the anastomosis, are in place before either the stomach or the intestine is opened. When the incisions are made the cut edges are in view, unrestrained by clamps, so that hæmostasis may be made absolute. Gastro-enterostomy with clamps is often followed by bleeding, and sometimes by a hemorrhage which necessitates reopening of the abdomen. I suspect also that the bruising exerted by clamps may be partly responsible for some of the cases of non-union of the sutured surfaces after gastrectomy for carcinoma, and perhaps also for some of the ulcers which occur at or near the line of anastomosis after gastro-enterostomy for peptic ulcer. Aside from these disadvantages which attend the use of clamps, they are always in the way, and occasionally, during gastrectomy, the one placed on the cardiac end of the stomach slips, especially when it is turned to facilitate suturing. If the stomach is well cleansed by gastric lavage previous to operation, if the patient is not allowed to retch during operation, and if the guide sutures are kept taut, and the site of anastomosis is well elevated above the incision in the abdominal wall, there is no danger of leakage from either the stomach or the intestine in the method I have just described. With this method there is less tension on the anastomotic sutures and less tendency to kinking than when the jejunum is anastomosed to the posterior wall of the stomach at a point which must, of necessity, be farther to the patient's left. In posterior gastro-enterostomy after partial gastrectomy there may be, from a theoretic stand-point, some danger that the gastric incision for anastomosis, which is usually parallel or nearly parallel with the sutured edges of the stomach at the line of amputation, may interfere with the blood supply to these sutured edges.

THE FUNCTION OF THE GASTRO-ENTEROSTOMY OPENING IN CASES OF PERMEABLE PYLORUS.*

BY HENRI HARTMANN, M.D.,
OF PARIS,

Professor of Clinical Surgery in the University of Paris.

WHAT becomes of the gastrojejunal mouth and how does it work in case of a permeable pylorus? Such are the two points to which I wish to draw attention.

I. *Does the gastro-intestinal mouth obliterate anatomically in case of patulous pylorus?* Kelling,[1] in Germany, suggested that in cases where the pylorus is free, the gastro-intestinal opening might be subject to anatomical obliteration in consequence of the fact that the chyme passes through the pylorus and does not pass through the artificial opening. His opinion has been accepted in France by Tuffier,[2] Reynier,[3] Jaboulay,[4] Mathieu,[5] Ricard,[6] and is almost general.

Personally, I disagree with this opinion, being unwilling to admit that the anastomosis thoroughly lined by a mucous membrane and free from any scar tissue should become obliterated merely because of its non-use. This would be against all the rules of general pathology.

When we refer to the cases of anatomical obliteration of the gastro-intestinal anastomosis, we see that these obliterations are in no way connected with the permeability of the pylorus.

In 45 cases of anatomical obliteration of the gastro-intestinal mouth, which we gathered in literature, we only found 4 cases of permeable pylorus. In 7 cases the cause of obliteration has been undoubtedly the secondary development and the cicatrizing of a peptic ulcer of the gastrojejunal mouth (Kauffmann,[7] Krönlein,[8] Navarro,[9] Gosset,[9] Leriche,[9] Oviatt[10]). In the 34 other cases the mechanism of the obliteration appears less distinctly. We observe, however, that in 23 cases buttons were used (Bérard [11] 1 case, Czerny [12] 4, Ettlinger [13] 1, Feldmann [14] 1, Ferrari [15] 2, Jaboulay [4] 1, Kehr [16] 1, Leriche [17] 1,

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* Read before the American Surgical Association, April 10, 1914.

W. Mayo[18] 4, Moynihan[19] 2, Schloffer[20] 5), that in 4 cases sutures were used (Eiselsberg,[21] Hartmann, Ricard, Tuffier), and that in 3 cases Y-shaped gastro-enterostomy was performed (Fedoroff,[22] Monprofit, Roux). In the last 4 cases technical details are lacking.

Briefly then:

(1) The obliteration of the gastro-intestinal mouth is in no way connected with the more or less permeability of the pylorus.

(2) Undoubtedly the obliteration results sometimes from the cicatrization of a peptic ulcer having developed itself in the mouth.

(3) The technic used has a direct bearing on the result. Obliteration of the anastomosis is exceptional in cases not operated with button or by the Y-method. On the other hand, the integrity of the anastomosis has been anatomically ascertained in cases of pylorus functionless, by Henck,[23] after 3 months, by Scheuen[26] after 28 months, by Busch[25] after 6 years, by myself after 5 years.

II. *Are the gastro-intestinal anastomoses functionally useless in cases of permeable pylorus?* In 1908, after summarizing the experiments made by Blake and Cannon, Leggett and Maury, Kelling, Delbet, Tuffier, adding to these experiments some radioscopic examinations on men, two observations of duodenal fistula by Berg, in which all the gastric contents passed through the fistula notwithstanding a gastro-enterostomy, Guibe[26] concludes: "All the experiments on animals and observations on men seem to agree sufficiently to prove that as long as the pylorus remains permeable, the stomach has an almost invincible tendency to drive out its content through this orifice without being inclined to utilize the artificial mouth. Nothing whatever passes through the new opening; on the contrary, everything passes through the pylorus."

This opinion, clearly expressed, may be considered as generally accepted, even up to this day.

However, when we read the reports of the radiologists, we see that the facts do not agree absolutely with these conclusions. Legueu[27] observes that in a case of permeable pylorus all the gastric contents pass through the mouth. Bèrard and Delbet[28] have shown us that the gastric contents pass as well through the mouth and through the pylorus. Pess,[29] after having studied 40 gastro-enterostomies by the X-rays, comes to the conclusion that the stomach (its pylorus being permeable or not before the operation) empties itself continually by the mouth and by the pylorus. Gray,[30] in a case of ulcer without stenosis, finds that the gastric contents pass specially through the mouth. Petrév[31] examines 9 cases of gastro-enterostomy for gastric lesion with integrity of the pylorus; 4 times all the gastric contents passed through the mouth, twice through the pylorus, 3 times through the pylorus and through the anastomosis. In 4 cases of normal pylorus, Härtel[32] finds that the evacuation takes place as well through the pylorus as through the mouth (1 case 2 years, and one 7 years after operation). Hesse[33] finds in 9 patients that the gastric contents pass through the mouth and through the pylorus.

These quotations prove sufficiently that the opinion of those who affirm the functional uselessness of the gastro-enterostomy in cases of permeable pylorus, is not as exact as they suppose, and that it is necessary to modify their too absolute affirmation.

To elucidate the question, I have made two kinds of researches:

1. Experiments on dogs.
2. Radiological examinations of patients.

EXPERIMENTS ON DOGS (IN COLLABORATION WITH MY PUPIL, M. MÉTIVET).

Dog 1.—Gastro-enterostomy joining the terminal portion of small intestine and pyloric antrum. Section of the intestine above the anastomosis suturing its proximal end to the skin, closing its distal end.

The dog lived 13 days without expelling any fæces through the rectum. We supposed that the anastomosis had not acted. At the postmortem, we found a stomach containing intestinal fluid, the efferent portion of the intestine being empty, and numerous adhesions at the point of the anastomosis. The fluid introduced into the stomach passed with much difficulty through the mouth.

Dog 2.—Gastro-enterostomy between the initial portion of small intestine and the fundus of the stomach. Thirty-seven days later, the dog is vomiting intestinal liquid and shows all the symptoms of intestinal obstruction. Next day we gave it 300 gr. of milk and half an hour later we killed it. At the post-mortem the stomach contained a yellowish fluid of fecal odor with clots of milk. This did not pass either into the duodenum, nor into the jejunum. The mouth was anatomically in good condition but obliterated by a bone which was impacted in its aperture and obstructed, on the other hand, the intestine. The intestine was distended by the liquid reaching the point of anastomosis and was contracted just behind the anastomosis.

Dog 3.—Gastro-enterostomy between the initial portion of the jejunum and pyloric antrum. Forty-four days after the operation the intestine is cut just above the anastomosis. The end in connection with the anastomosis is closed and the duodenal end is fixed to the skin.

The next day a meal composed of milk and hashed meat is given to the dog, which it eats with good appetite. After 7 or 8 minutes some bile is coming out of the duodenojejunal opening and 15 minutes afterwards a few small curds of milk mixed with the bile. Half an hour after the meal the dog is killed. In the duodenum some bile and a few curds ot milk are found representing what has passed through the pylorus. In the jejunum, at a distance of about 65 to 70 cm. one perceives a quantity of clots of milk and some particles of meat, showing what has passed through the gastro-intestinal mouth, which is normal, the pylorus likewise.

Dog 4.—Gastro-enterostomy between the initial portion of the jejunum and the pyloric antrum. Forty-six days after the operation, the intestine was cut above the anastomosis, exactly as in the former cases, the end attached to the stomach was closed, and the duodenum fixed to the skin.

After 3 days, 400 gr. of milk were given, 10 minutes later, a small quantity of milk was flowing through the duodenal fistula. The animal was killed 20 minutes later. In the duodenum we found some curds of milk which had passed through the pylorus. In the jejunum, for a distance of more than 1 metre, the intestine was full of curds of milk. Artificial opening and pylorus both normal.

Dog 5.—Gastro-enterostomy between the jejunum and fundus of the stomach. After a month, section of the intestine above the anastomosis, closing the gastric end and fixing the duodenal end to the skin.

The next day 400 gr. of milk and hashed meat is given to the dog. After two minutes and a half, milk begins to flow abundantly through the duodenal opening, mixed with a few particles of meat. Ten minutes later about 150 gr. of milk are flowing. The animal is killed 10 minutes after the meal. We find in the duodenum a great quantity of milk and particles of meat which passed through the pylorus. In the jejunum at about a distance of 10 to 20 cm. we see some clots of milk and some particles of meat, representing all that had passed through the anastomosis. Artificial opening and pylorus both normal.

Dog 6.—Gastro-enterostomy between the initial portion of the jejunum and the fundus of the stomach. Thirty days after the operation, after having removed an adhesion, which united the anterior part of the stomach with a point of the efferent part of the jejunum, situated 9 cm. below the anastomosis, we cut the intestine across above the anastomosis, closing the gastric end and suturing the duodenal end to the skin.

The next day a meal of milk and hashed meat was given to the dog. Seven minutes later, the milk and some particles of meat were passing through the duodenal aperture. The dog was killed half an hour after the meal. The duodenum contained some curds of milk and some particles of meat; the jejunum contained milk and meat in its first centimeter. Gastro-anastomosis and pylorus both normal.

Dog 7.—Gastro-enterostomy between the initial portion of the jejunum and the pyloric antrum. Two hundred and twenty-three days after the operation, second operation (June 22, 1912). Section of the jejunum above the anastomosis, closing the gastric end and suturing the duodenal end of the skin. 20 cm. below the anastomosis, the jejunum is cut through a second time, closing the distal end and fixing the proximal to the skin.

The next day, 100 gr. of milk is given to the dog; 1 minute later liquid begins to flow through the jejunal fistula (corresponding to the anastomosis); 2 minutes and a half later a large amount of bile is flowing through the duodenal fistula. These liquids are collected and preserved. About a quarter of an hour later, the liquid coming from the jejunal fistula is no longer clear, a fresh sample is put aside. These different liquids are analyzed by W. Fabre. During the first quarter of an hour, bile flowed through the duodenal fistula and acid liquid through the jejunal fistula. After a second quarter of an hour, bile was coming through the duodenal fistula, the jejunal fistula giving a liquid containing ozazone (specific of lactose) which W. Fabre could not find in the bile coming through the duodenal fistula. Next day half a pint of milk is given to the dog. It is killed an hour later. The stomach contains an almost clear liquid with some curds of milk; the duodenum is full of bile and some few curds of milk. The piece of jejunum connected with the gastric mouth is full of curds of milk. The mouth is normal, so is the pylorus.

In none of these experiments did we find the mouth obliterated, nor thickened, even after having kept the dog alive during a long time, 223 days in one case.

As for the functions of the mouth, we may leave aside the experiments 1 and 2. In the first, function was prevented by adhesions and angulation; in the second, the dog died the thirty-seventh day in consequence of an intestinal occlusion produced by a bone obstructing the mouth and the intestine just in front of it.

In 2 cases, in which the mouth was made on the fundus, the gastric contents passed at the same time through the mouth and through the pylorus, but the greatest quantity through the latter.

In 3 cases, in which the anastomosis was made on the antrum, 44, 50 and 223 days after the operation, the gastric contents (milk and meat) passed through the artificial mouth almost entirely.

These experiments show that the evacuation is done principally through the anastomosis if it is situated on the pyloric antrum, through the pylorus if it is situated on the fundus of the stomach.

If previous experimentators saw the gastric contents passing almost altogether through the pylorus, it was probably because of their having made the anastomosis on the fundus of the stomach. It is the fundus which presents when opening the abdomen of a dog, and it is this part of the stomach which is brought out. Therefore, it is the natural portion used for anastomosis. The pyloric antrum, on the contrary, is situated deep under the liver and it is necessary to pull it out to bring it to light. It is, therefore, only when one has the fixed intention of making the anastomosis on this part that one is at all likely to do so.

Most probably Kelling, Delbet and Tuffier operated on the cardiac part of the stomach. As for Tuffier,[34] we are quite sure of it. He says: " I remind you how easy it is to observe on a dog, making use of X-rays, that everything passes through the pylorus, because we know, when operating on a dog, that the new pylorus can only be placed at a distance of 25 cm. from the normal pylorus and not less."

In the experiments on cats of Cannon and Blake, 8 times gastric contents was forced out naturally by peristaltic waves through the pylorus; only 2 exceptions were observed, food leaving by both exits; in one of these two cases the stoma was in the posterior wall of the antrum close to the pylorus, in the other about half-way between the two ends of the stomach.

Calabrene, who paid attention to place the mouth near the pylorus, notes that the contents of the stomach pass through the anastomosis.

These different modes of evacuation of the gastric contents, according to the position of the artificial opening, find their explanation in the differences of the muscular contractions in the different zones of the stomach. In order that the gastric contents may pass from the stomach into the intestine, the pressure to which it is subjected must be greater than that of the intestinal contents.

Experiments show us that the pressure, which is very weak in the fundus, gets stronger in the antrum and that even in the latter it is subjected to considerable variations, getting considerably stronger at the very moment of the gastric contractions. Von Pfungen, in 1887, measured intragastric pressure on a boy with a gastric fistula. The pressure in the fundus varied only from 5 to 10 mm.; in the region of the pylorus, the pressure was greatly increased and varied from 40 to 80 mm. mercury, in connection with its peristaltic contractions.

Hofmeister and Schutz had observed likewise a very great difference in the form of contractions of the two parts of the stomach, in their experiments on dogs. Moritz has seen, in his observations on men, that as far as the left part of the stomach was concerned, he observed only very rare and slight variations of pressure, from 2 to 6 cm. of water, meanwhile, he found that in the pyloric region the energic contractions of the gastric muscle were very frequent, and capable of making the water rise up to 50 cm.

All the investigations agree to make us consider, with Gray and others, that the stomach consists of two parts, the cardiac part acting as a reservoir and the pyloric part as a motor.

One understands, therefore, that the juxtapyloric anastomosis works actively even when the pylorus is normal, and that the anastomosis on the cardiac part is functionless in cases of a permeable pylorus.

Radiological Examinations (in collaboration with Dr. Maingot, radiographer of the Loumec Hospital and Wolfram, junior demonstrator in anatomy).—The radiological examinations on man have confirmed the results of the experiments on dogs. Our anastomoses have almost always been placed on the lowest part of the pyloric antrum. In consequence, we observed that the evacuation of the gastric contents takes place partly through the anastomosis, partly through the pylorus.

To be quite certain of the exact point of passage of the bismuth, the examination of a skiagram is insufficient. In cases where the bismuth has passed through the pylorus, it happens that the skiagram shows a loop leaving the greater curvature and giving the illusion of a passage through a gastro-intestinal anastomosis, whereas this appearance is due to the fact that the initial portion of the duodenum is overshadowed by the stomach, the jejunal shadow only separating from that of the stomach below the greater curvature. It is indispensable to make a skiascopic examination. One then sees the bismuth pouring into the stomach and passing through the anastomosis before reaching the pylorus. In this way it is impossible to mistake the evacuation through the anastomosis for an evacuation through the pylorus.

The evacuation through the anastomosis does not always take place in the same way: On 19 of our patients without a sign of gastric stasis before the operation and no sign of pyloric stenosis during the operation, we observed after intervals varying from 1 to 11 years:

Once, everything passed through the pylorus; 11 times everything passed through the anastomosis; 7 times the bismuth passed both through the anastomosis and the pylorus.

Sometimes, the passage was almost immediate; in other cases the passage took place by instalments, succeeding each other at short or long intervals; in some cases the evacuation began with a gush and continued by repeated instalments.

The results of radioscopic examinations are therefore in accordance with the results of the experiments and show that, in opposition to the general opinion, the gastro-intestinal anastomosis may work even in cases where the pylorus is patulous.

We have found these results interesting enough to draw your attention to them even if they have not considerable practical importance and if they do not prevent many surgeons from continuing to exclude in many cases the pylorus.

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CHRONIC PANCREATITIS.*

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As a direct object of surgical attack the pancreas remains to-day the most unpromising of all essential organs. Complete removal is homicidal, partial excision is difficult and but rarely indicated by the character of its diseases, and direct drainage can be accomplished only in very imperfect fashion at best. In the past few years much has been added to our knowledge of pancreatic disease, its frequency and its pathogenesis. As surgeons we should derive some therapeutic gain. It is in the hope of clarifying our position in respect to chronic pancreatitis that we offer these brief observations.

Our difficulties in dealing with chronic pancreatitis are greatly increased by the fact that we possess no definite syndrome of signs, symptoms or laboratory tests by which an early clinical diagnosis can be made and the situation is further complicated by the existence of the disease in two chief forms, one of which involves particularly the interlobular septa and the parenchyma of external secretion, while the other attacks chiefly the islands of Langerhans and only in lesser degree the secretory tubules and interlobular structures. In the interlobular form of the disease digestive symptoms predominate. In disease of the islands of Langerhans, as is well known since the researches of Opie, disturbance of carbohydrate metabolism results, manifesting itself in the more pronounced cases as diabetes. Both these processes when clinically recognizable and demonstrable are characterized pathologically by parenchymatous degenerations of advanced degree and the deposit of fibrous tissue and fat in the gland.

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* Read before the American Surgical Association, April 9, 1914.

When this state of affairs is present it is useless to expect cure in the sense that the damage done may be repaired or even compensated for in any marked degree. It is quite comparable to chronic nephritis of the type characterized by deterioration and degeneration of the renal cells with interstitial fibrosis. Partial or complete arrest of the process may at times be effected by removal of the cause of the disease or by careful palliative treatment along empirical lines. But for practical purposes we may consider such cases as having acquired a chronic condition that will necessitate at best a degree of invalidism and in general will sooner or later, directly or indirectly, be responsible for the death of the individual so affected. We have on a number of occasions had the opportunity of reopening the abdomen in a case the subject of chronic indurative pancreatitis and in no instance have we witnessed a return to a normal condition. We have also operated upon a number of cases of diabetes in which there was good reason to believe that the process was inaugurated by inflammation of the biliary passages. In no case of well established diabetes did a cure of that condition result, so far as we are able to determine. On the other hand, transient glycosuria, present during exacerbations of biliary and pancreatic disease, we have seen entirely relieved by appropriate operative treatment of the underlying condition. These experiences clearly point the lesson that treatment of the chronic form of pancreatic disease must be directed at the early stages if it is to be effective. We must prognosticate the probable course of early lesions and act with promptness in order to prevent their development.

Owing to the inaccessibility of the pancreas and the difficulties of observation, the slow transitional gradations from early lesions to late effects have never been followed in the individual, nor has a complete series of changes been compiled by the pathologist because of scantiness of early material, and the difficulty of study of finer parenchymatous changes, owing to the self digestion of the organ which begins probably in the agonal stage and rapidly proceeds in the first few hours after death. We must, therefore, have recourse to deduction based upon operative findings, clinical experiences and, only to a lesser degree, upon the late findings of the mortuary.

Several facts have been established. First, a very considerable proportion of pancreatic inflammation is associated with, and in all human probability secondary to inflammatory lesions of the alimentary tract and its derivatives. The biliary tract and the duodenum head the list by reason of their contiguity. There is reason to believe that the stomach, the appendix and possibly the colon and remainder of the intestine may at times be primarily responsible.

The second fact of importance and one which has been repeatedly verified is the common involvement of the head of the pancreas and the relative immunity of the body and tail of the organ in inflammations transmitted to it from an inflamed biliary tract or duodenum. As we have pointed out previously, this behavior does not square with the current conception of the pathogenesis of pancreatitis, namely, that it is in the majority of cases a duct borne infection. It is difficult to conceive of an infection of the ducts which could so generally select but one portion of the duct distribution as its seat, to the exclusion of the other areas communicating just as freely with the terminal ducts of discharge. Would we not rather believe on anatomical grounds that the head of the pancreas would show the lesser lesions, since in a considerable proportion of cases it possesses an additional functionating path of discharge of its secretion through the duct of Santorini, which can in no way be affected by what has been aptly termed the "unfortunate association of terminal facilities" of the duct of Wirsung and the common bile duct?

A better explanation of the early pancreatic swellings and inflammations seen at operation exists in the close association of the lymphatics of the gall-bladder, the liver and the duodenum with those of the head of the pancreas. In former communications we have described the lymphatics leading from the gall-bladder, the bile ducts and the duodenum in their relation to the head of the pancreas where they anastomose intimately with the lymph-vessels of that organ. We have observed clinically indications of the march of the infection most typically in cholecystitis where, in sequence, we have found the inflamed gall-bladder, enlargement of the cystic lymph-gland, infiltration of the gastrohepatic omentum, hyperplasia of the glands about the common duct, peripancreatic infiltration and enlargement of the head of the pancreas. We have shown that the areas of pancreatic infection correspond with the lymphatic distribution and not with the duct distribution. For this condition we have adopted the term pancreatic lymphangitis, proposed by Arnsperger, and have suggested that the condition probably is, in a percentage of cases at least, the forerunner of the alterations characteristic of chronic pancreatitis.

This condition occurs with cholecystitis with or without stones. It is, so far as we are aware, undiagnosable, except by direct inspection and palpation at operation. It cannot, therefore, be regarded as an indication for operation except in the cases characterized by more persistent and severe exacerbations.

Our knowledge of the existence of this condition must affect our ideas of treatment in two ways: First, in emphasizing the necessity of prompt and radical treatment of abdominal diseases, particularly those of the gall-bladder, which do not yield readily to internal measures; second, in influencing our operative procedures in cases where this condition is present as a complication during operation. A recent instance of the disasters of delay in cholecystic disease is the following:

The German Hospital, white, female, thirty years old. Pain in epigastrium and back. Since July, 1913, has had nine attacks of very sharp pain, beginning between shoulder-blades, radiating front to gall-bladder area, relieved by morphia. Each attack lasts about one week, followed by soreness in upper abdomen and jaundice. March 23, had a severe attack of this pain, with chills, fever, and collapse, and uncontrollable vomiting, followed by jaundice the following day. Pain and jaundice have persisted.

Bowels have been regular. Stools have not been clay colored. Micturition normal, but the urine is very dark.

One child four months old. Menses just beginning. Appendicitis six years ago—not operated. Abdomen: palpable enlargement in epigastric region, extending into gall-bladder region.

Operation (April 1).—Findings: extensive fat necrosis and acute suppurative pancreatitis; pus confined to lesser peritoneal cavity.

Blood Count.—Polynuclear neutrophiles, 87; lymphocytes, 7; leucocytic mononuclears, 9; hæmoglobin, 70; red blood cells, 4,180,000; white blood cells, 27,750.

Test Breakfast.—Free HCl, 41; total acidity, 90.

Cammidge "C" Reaction.—Negative. Culture pus pancreatic. Collection, no pus.

Stool.—Occult blood: Ft. positive to benz.; negative to guaiac. Bile: vert ft. positive.

The effect of our knowledge of the dissemination of infection by way of the lymphatics has been to diminish our faith in simple drainage of the gall-bladder or ducts as a cure-all for biliary and pancreatic infection. It is well known that there is a percentage of recurrences of biliary infection after drainage operations. This is more common in simple cholecystitis than in calculous disease of the gall-bladder or ducts. In a considerable number of cases obstruction of the cystic, common or hepatic ducts seems to play no part. At least there is no evidence of obstruction in the shape of a demonstrable cause or in dilatation of the ducts by back pressure. In such cases, however, mucosal and interstitial infection of the wall of the gall-bladder may be present. If it is not dependent upon intermittent or constant obstruction for its foothold it is not likely that freer drainage will completely dislodge it and it is in these cases that our operative results have proved most unsatisfactory from the stand-point of permanent cure. It is true that some cases are cured and the majority benefited temporarily by simple cholecystostomy, and reasoning along these lines it has been proposed to do cholecystoduodenostomy, -gastrostomy or -enterostomy in cases complicated by chronic pancreatitis, with the idea of providing permanent free drainage. Unfortunately for the idea it has been found that such a fistulous opening does not remain permanent in the absence of an obstruction to the natural course of the bile. There is but one course open, therefore, which is the removal of the gall-bladder, in which, as a rule, the lurking place of the infection is found. While for years we defended cholecystostomy and decried cholecystectomy except for the most evident indications, we have come to believe that the field for cholecystectomy should be widened and that all gall-bladders should be removed that show evidence of chronic infection independent of obstruction and particularly so if the pancreas is involved. We believe also that in calculous cholecystitis, which shows evidence of marked interstitial disease and disseminated lymphangitis the chances of permanent cure are enhanced by cholecystectomy.

Naturally in each case good surgical judgment will weigh the increased immediate danger of an operation of greater magnitude against the question of permanence of results. In suitable cases with good technic we do not believe that the danger will be much, if at all, increased by cholecystectomy. Such has been Kehr's experience. In this country cholecystectomy has had a distinctly higher mortality, which is due chiefly to the fact that it was reserved for more serious and complicated cases. Still, in the presence of great operative difficulties or when dealing with a poor surgical risk, we would not advocate cholecystectomy for these indications, since simple drainage cures many and it is our creed, frequently stated, that a living patient after two operations is better than a dead patient after one thorough operation.

Another point of great importance is drainage of the common duct in connection with cholecystectomy. This is best done with the T-tube. It should never be omitted for the reason that it greatly diminishes immediate danger and renders recurrence less likely. We always run a risk of misinterpreting the basic lesion and we are not willing to discard the known benefits of drainage in so many cases. It is possible also by choledochotomy to pass a searcher into the ducts and down into the duodenum and thus dismiss the possibility of stone or stricture. There is a group of obstructive cases in which the only cause that can be found is stenosis of the papilla of Vater. Whether this is due to a spasm of the sphincter of Oddi or to inflammatory changes in the tissues surrounding the orifice is not definitely known in all cases. Certainly many are inflammatory and particularly those cases of complete and lasting obstruction associated with jaundice cannot be interpreted as sphincterismus. It seems not unlikely, however, that spasm of the sphincter does occur and is productive of symptoms. Divulsion of the papilla by a large searcher or gallstone scoop is curative in these cases. When the gall-bladder is removed we must realize that we are taking away the " tension bulb " of the biliary tract, the mechanism by which transient back pressure is prevented from exerting its full effects upon the liver directly. It is of paramount importance, therefore, to be sure that nothing exists in the nature of an obstruction to the free discharge of bile into the duodenum. Slight or intermittent obstruction at the papilla is not sufficient to enable the surgeon to recognize the condition by the appearance of the common duct and it is therefore wiser to eliminate it in the manner here suggested.

Finally, it must be said that the most important message that the surgeon has for the profession, as the result of the increase of knowledge of pancreatic disease made possible by the autopsy *in vivo,* is the necessity of referring intractable dyspeptics to the surgeon. It is not enough that the internist by diets, drugs and trips to Carlsbad, French Lick Springs and the like can lull infected gall-bladders and ulcerated duodenums into temporary quiescence. If by recurrences and chronic disturbances it is evident that sterilization of the infected area has not been accomplished, he should realize that he is exposing his patient to the most serious damage to the parenchyma of essential organs which can never be repaired.

SUGGESTIONS REGARDING THE ANATOMY OF AND THE SURGICAL TECHNIC IN THE TREATMENT OF JONNESCO'S MEMBRANE.*

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In a paper which I read before the Surgical Section of the American Medical Association at its last meeting in Minneapolis, entitled "Surgical Aspects of Intestinal Stasis, from an Anatomic Point of View," I asked discussion upon the following points:

1. If the Jonnesco-Jackson-Reid membranes are congenital, are they always more or less clearly demonstrable in every individual, should the incision admit?

2. Are the membranes purposive? If so, are they not intended by nature as ligamentary supports—preventive of intestinal stasis rather than causative?

3. Therefore they should be divided only after they have become restrictive of intestinal function, from loss of nervous and muscular tone resulting from chronic intestinal toxæmia.

4. Is the method of demonstrating the so-called "white line" always reliable? If so, does not this in itself prove the congenital origin of the membrane and its physiologic importance?

I believe that every thinking, informed man to-day should concede that all of these membranes are congenital; the demonstrations by Flint, Rilus Eastman, and others, clearly show this, and I have had so much personal corroborative evidence that these membranes can be demonstrated to a greater or less degree in every abdomen when the incision admits of a thorough inspection, that I am no longer in doubt as to this, to me, established fact, and many of my friends are agreeing with me—some of them men of the widest experience in abdominal surgery. As Sir Arbuthnot Lane in one of his papers writes, " acquired mesenteries and adhesions," as he is pleased to call them, " were absolutely and categorically denied by physicians experienced in post-mortem work, who appeared to think that, because they had escaped their observation as many things have done and will continue to do, they were justified in denying their existence in the most dogmatic manner possible." Many of these friends of mine who now agree with me as to the position that I take in this matter, formerly smiled, if they did not disagree. Now that they are looking for themselves they see with the same eyes that I do. The study of anatomy at the operating table has impressed me more and more, that the viscera of men differ in as great a degree as do their faces—there are no two exactly alike.

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* Read before the American Surgical Association, April 9, 1914.

If the Jonnesco-Jackson-Reid, etc., membranes are congenital and always more or less clearly demonstrable, then they *must* be purposive and intended by nature as an aid in carrying out the function of the bowel, and it is only when the arrangement of these membranes is at variance with the conduct of the normal function of the bowel, that the membrane becomes pathological, and this arrangement may be defective or restrictive—defective when the bowel is not properly supported, restrictive when its function is restrained or inhibited. Neither of these conditions is apt to be observed in childhood. The muscular tone is so positive in childhood and youth that the peristaltic action of the intestine overcomes minor difficulties. It is only when this tone, from physical conformation of the skeleton, habit, or long continued over-strain, becomes lessened, that a too loosely supported bowel or a too tightly restricted bowel is unable to functionate without the development of more or less intestinal stasis with its accompanying symptoms. As Mr. Gray puts it (*British Medical Journal*, January 24, 1914), it is the *manner* of attachment of the membranous bands to the bowel or its mesentery that causes stasis. I have seen the so-called Jackson-Jonnesco membrane in a considerable number of individuals under twenty years of age, but have never seen symptoms produced in any one under seventeen years of age. Van Buren Knott tells of two infants under one year of age, with most extensive Jackson membranes, upon whom he successfully operated for intussusception, the Jackson membranes having nothing to do with the cause of the intussusception, and the infants being in good health succeeding the operations, with normal bowel function. Most of the cases that I have observed where abdominal symptoms were dependent upon *defective* or excessive envelopment of the bowel in a so-called Jackson membrane, were in people over thirty years of age, and in several they have been between fifty and sixty years of age. The intestinal wall loses its tone just as the bladder may lose its tone from the various causes that produce it. Therefore, two lines of procedure may be required for the relief of intestinal stasis and the accompanying symptoms—the *one* to release the bowel so as to permit of freer function, the *other* to support the bowel, thereby increasing its muscular tone. In excessive angulations from membranous restrictions it may be advisable to relieve the resulting stasis by an exclusion of the colon. I am not as yet prepared to admit the justifiability of its excision. Even without angulating bands involving the cæcum and lower ileum, stasis in the ileum may be demonstrated as caused by an incompetency of the ileocolic valve. J. T. Case (*Medical Record*, March 7, 1914) has found by X-ray observation 250 cases of this kind in an examination of 1500 people in whom the competency of the valve was tested by the bismuth enema, and Kellogg (*Surgery, Gynecology and Obstetrics*, November, 1913) has reported a number of patients successfully operated upon for stasis of the lower ileum, the result of damming back from the colon because of incompetence of the ileocolic valve. So it is again seen that congenital membranes and bands of the right iliac fossa may in themselves be innocent of mechanically causing auto-intoxication. As Kellogg says, "the remarkable advances made in the technic of the X-ray study of the alimentary tract within the last few years, have rendered invaluable service in making it possible to locate the cause of obstruction in these obstinate cases." Further experience has convinced me that the so-called "white line," which I believe to be the line of fusion of the duodenal and colonic peritoneum with the parietal peritoneum after rotation of the duodenum and colon has been completed, is always demonstrable whenever the pericolic membrane can be shown, and it is the line of attachment of the pericolic membrane to the parietal peritoneum. It is demonstrated by rotating the attached hollow viscus in a direction continuous with the course of the blood-vessels and fibres of the membrane. I have called this "white line" the *ligamentary attachment* of the pericolic membrane to the parietal peritoneum. Usually, when it may be deemed best to release the intestine from the investment of this ligamentary support—the pericolic membrane—it should be divided along its loosest line of attachment; however, greater motility may be obtained in some instances by dividing the membrane at its base—the "white line"; when this line is short, as it frequently is in the hepatic region, the raw space, left by the division of the line in the direction with its course, can be closed by suturing at a right angle to the line of division. If the "white line" is a long one, as it sometimes is in an extensive membrane enveloping the ascending colon, this is not practicable. When, in addition to the presence of a Jackson membrane, there is a marked ptosis of the hollow viscera, particularly the cæcum and transverse colon, the membrane should not be divided, but some of the methods advocated by Coffey and Connell are indicated. I have found, however, in women, that a properly fitted, front-lace, straight front corset, will relieve many of the symptoms that depend upon these ptoses, provided proper habits of life are observed.

BULLET IN THE PERICARDIUM.

AURICULAR FIBRILLATION.

BY GEORGE E. ARMSTRONG, M.D.,

OF MONTREAL.

THERE was admitted to the Royal Victoria Hospital, Montreal, on Feb. 17, 1913, an Italian, aged 46, complaining of a wound in his chest.

He says that he was treated for pneumonia in this hospital nine years ago. He has taken alcohol very freely.

He stated that at 5 A.M. on the day of admission he was shot by his son. The assailant used a 32 calibre revolver and stood in front of him and about five feet away. The patient says that he was dazed for a moment and then recovered and pursued his assailant, but was unable to run far on account of weakness.

He is a well-developed, well-nourished Italian. He can assume any position, complains of but little pain. There is no respiratory distress. His general condition is good. Pulse regular and not rapid. There is a small punctured wound opposite to the third intercostal space and slightly to the left of the border of the sternum. There is no staining or charring of the skin and but little tenderness on pressure. There is no discharge from the wound and very little discomfort on taking a full breath.

The chest is emphysematous, but there is no evidence of pneumothorax or of air or blood in the pericardium. No murmurs can be heard nor any friction rub. An examination of the abdomen was negative. In the afternoon the pulse became irregular, missing every fourth to tenth beat.

A fluoroscopic examination of the chest showed the bullet lying loose in the pericardium, moving with each heart beat, and changing its position with the changing position of the patient. If the man lay on his right side the bullet rolled to the right, and back again to the left when the man rolled on his left side. The bullet seemed to lie most naturally toward the right. Marked irregularity in the pulse developed when the patient was moved frequently from one side to the other. In the late afternoon a slight cough developed.

During the succeeding four or five days, the only changes to be noted were increasing irregularity of the pulse and a change in his general condition. It was evident to everyone that the man was losing ground. The temperature elevation was not great, a hundred and two-fifths was the highest. The change in the pulse was definite. It became more rapid, more irregular, and smaller and more compressible. Two physicians, Drs. Martin and Hamilton, saw him with me daily and the different views soon took definite form and largely on one issue. None of us had had any experience in similar cases to guide us. The important question at the moment was, Should the bullet be removed or not? The physicians inclined to the view that the bullet had done its work. That there was, very likely, an injury to the heart, either to the auricle or to the ventricle or the auriculoventricular groove, but that the bullet now lay free in the pericardium and that it was a matter of no importance whatever to the patient whether the bullet was removed or not. Against this theory was the daily, progressive, general failure in condition and the increased rapidity and irregularity of the heart's action. The proposal to remove the bullet was finally assented to on the ground that he would be no worse afterward and might be better. A tracing showed complete auricular fibrillation.

A radial tracing showed an irregularity both in volume and rhythm; the figures under each pulse period indicate the duration in seconds. Lime marker in 1/5 seconds.

On comparing the radial with the venous tracing it can be seen that the irregularity is not due to extra systoles. There was a marked and rapidly irregular pulsation of jugular veins in the neck. The venous tracing is of the so-called ventricular type, showing the same irregularity as shown in the radial with an utter absence of any wave due to auricular contraction. The carotid and " V " waves are the only waves represented.

This combination of an absolute irregularity and absence of any sign of a regular and definite auricular contraction can be due to only one condition, viz., auricular fibrillation.

In the afternoon of the fifth day I removed the bullet. Ether was administered by the intratracheal insufflation method.

Wilm's intercostal incision through the fourth intercostal space brought me readily down upon the pericardium. The internal mammary artery was divided between two ligatures. The pleura was opened and the lung allowed to collapse moderately. A rib-spreader was inserted and the pericardium opened. I now passed my finger within the pericardium but could not feel the bullet, although the patient was rolled from one side to the other. A portion of the fifth rib was resected and I could then pass two fingers in and feel the bullet lying directly behind the heart. By rolling the patient well over on his left side the bullet came readily within reach of my fingers and was hooked out. There was little blood or effusion in the pericardial sac.

The opening in the pericardium was then closed with catgut sutures without drainage. A little increase of pressure in the intratracheal apparatus brought the lung out to the level of the incision in the chest wall, which was then closed, leaving very little if any air in the pleural cavity.

Throughout the operation for the removal of the bullet the pulse retained the same characteristics and a rate of 130 to 140, varying slightly throughout the anæsthesia. After the bullet was removed and before the pericardium was sutured the pulse obviously quieted and the rate was 120 at the carotid.

Two and a half hours after the operation the pulse was 105 and perfectly regular.

A tracing taken the same morning showed what to all intents and purposes was a normal tracing, a well-marked and large auricular wave and a large onflow wave.

The radial tracing was regular in volume and rhythm and showed a rate of 90 per minute.

CONCLUSIONS.

1. Onset of auricular fibrillation in a heart where, as far as could be ascertained, there had been no previous inflammatory mischief, no symptoms of any cardiac involvement, due to the presence of a foreign body.

2. Cessation of the disorderly rhythm on the removal of the cause—the bullet.

3. A rare opportunity of observing the heart in such a rhythm.

We have been unable to find any reference in literature to a similar condition.

PULMONARY ABSCESS AND BRONCHIECTASIS.*

A CLINICAL REPORT.

BY HOWARD LILIENTHAL, M.D.,
OF NEW YORK,
Attending Surgeon to Mt. Sinai and Bellevue Hospitals.

SINCE the application of intratracheal anæsthesia to the human being early in 1910, with the simplification of differential pressure methods in endothoracic operative work, I have been greatly interested in the new possibilities of lung surgery. Believing that there is a peculiar interest and value in studying the methods and results of an individual surgeon, I venture to offer a series of histories and notes representing my own work since 1910 in cases of lung abscess and bronchiectasis.

There have been a number of other thoracic cases, but I have limited this paper to a consideration of the suppurative non-tuberculous lung infections.

There were fourteen operations on eleven patients, and there were but three actually "*cured.*" Two cases are still unfinished and cannot be included in my table, though I present abstracts of their histories. One patient was not operated upon.

Five operations were followed by visible improvement, and there were four deaths.

Two of the fatal cases (VI and VII) I consider to have been hopeless. One of the other two might have survived for a time (Case II) had I been satisfied with a mere "operative" recovery. Case VII might perhaps have recovered with better technic.

Of the eleven patients operated upon five had bronchiectases and of these one patient died in the hospital. The others were more or less improved. One died about a year later of hemorrhage.

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* Read before the American Surgical Association, April 10, 1914.

There were three cases of acute abscess and two of the patients recovered.

One of chronic abscess recovered.

One of acute extensive gangrene died.

One of fetid bronchitis with minute abscesses died.

Hemorrhage (hæmoptysis) was prominent in four of the bronchiectatic cases, and in these resections of the thorax certainly did result in benefit, in two of them the tendency to hemorrhage having been temporarily checked. Indeed, obviously insufficient operative attempts were several times followed by decided improvement, both subjective and objective (lessening of the amount of expectoration).

Clubbing of the fingers was a prominent phenomenon in the chronic cases, the appearance even in little children being most striking (see Fig. 1).

In trying to arrive at an exact differential diagnosis of chronic intrapulmonic suppurations it must be remembered that as a working rule all may be regarded as "lung abscesses." A lung abscess may begin outside the lung itself, as, for example, in an empyema, and the secondary abscess may even drain itself through a bronchus. Occasionally the radiograph may show a level liquid surface-line with clear space above and opacity below (see Fig. 2). But when it comes to the operation we must be prepared for surprises.

The surgeon must possess that quality of mind known as *imagination*. He must have the faculty of producing a distinct mental image showing, as it were, the physical characteristics of the object with which he has to deal. He must have in his mind a picture of the morbid part formed with the help of all the diagnostic aids at his command—and at the same time he must keep an open mind and change his preconceived idea and also his plan of action as the progress of the operation or of the disease indicates previous error.

Although bronchoscopy was practised in but two of the cases in this list, I have had the advantage of this important diagnostic aid in several other cases and shall employ it when feasible whenever a pulmonary operation is contemplated.

In addition to the possibility of finding an unsuspected foreign body some points of pathological anatomy can be cleared up with a certainty at least as great as that achieved in urological cases by cystoscopy.

My attempts at cure by operation were: Thoracotomy and drainage.

Thoracoplasty for reducing the capacity of the affected side.

Extrapleural tamponade (Tuffier).

Extirpation of the affected part of the lung.

I have been surprised in some of my cases, especially those of bronchiectasis, at the tremendous toughness, thickness and rigidity of the inflammatory tissues surrounding the diseased focus. This point alone is enough to convince one of the futility of treating these cases by artificial pneumothorax and to make one doubt the efficiency in indurated bronchiectasis of Tuffier's method of extrapleural plugging, which he has so successfully employed in apical tuberculosis.

Briefly, this operation consists in the careful digital dissection of the unopened apical pleura from the endothoracic fascia through an intercostal incision; the forcing downward of the entire apex compressing the lung tissue so as to leave a great hollow where the apex was; then the implantation of living tissue, either fat or benign tumor substance, so as to fill completely the dead space; finally, the closure of the wound by suture. I would suggest as a name for this ingenious operation biotamponade—or if fat is used, lipotamponade.

In old cases of fetid bronchiectasis with the usual mixture of bacterial strains and with intimate adhesion between the visceral and parietal pleuræ, there is a very real danger of infecting the tissues surrounding the newly made extrapleural cavity even without breaking into the septic focus. This danger is obviously less when we are dealing with a pure tuberculosis.

The two-stage operation in certain forms of true lung abscess may be an advantage. At first the free pleural cavity is opened, inspected and palpated, and the extent and character of the disease ascertained. A few days later the drainage operation may be undertaken with increased accuracy and better chances of success. The general pleural cavity can be well protected, even in the neighborhood of suppuration (see Case VIII and Case IX).

If the operation is to be performed with a view to resection of the diseased lung, however, one sitting is best.

Differential pressure, however attained, is a valuable aid in chest surgery, but it must be understood that most of the commoner operations upon one lung can be done with anæsthesia managed in the ordinary way.

No major work through the thoracic cavity should be undertaken without full narcosis.

Anæsthesia by intratracheal insufflation has been a great comfort in many of these cases and its application tends to become simpler. Still, in spite of the beautiful, almost automatic, character of this method of anæsthesia it is far from "fool-proof," and there should be the most scrupulous attention to details. The apparatus must be tested immediately before using it. A supplementary bellows must be at hand in case the electricity fails, a woven trachea tube of proper size (1/3 to 1/2 the calibre of the trachea) must be selected and inserted under the guidance of the eye. During the entire operation the air pressure and the strength of ether mixture must be carefully observed. Even when everything is running smoothly and the patient's color is good the pressure should be completely shut off for a few seconds every minute. And there are a number of other points which it is not necessary to mention here. However, the technic is not difficult to acquire and it can be well studied by experiment in the ordinary run of surgical cases in which the differential pressure element is not an essential factor.

REPORTS OF CASES WITH CRITICAL REMARKS.

CASE I.—*Bronchiectasis.* B. F. Exploratory thoracotomy in intratracheal anæsthesia.

The history of this patient has been reported and may be found in the ANNALS OF SURGERY for July, 1910. It was the first case in which thoracotomy in a human being had been performed with the aid of intratracheal anæsthesia. The disease had been characterized by the usual profuse expectoration and by severe attacks of pulmonary hemorrhage. The operation was an exploration which revealed the site of the tough adhesions in the right subscapular region (indurative bronchiectasis—Hoffmann). The hand within the thorax, aspiration through the sound chest wall was practised but the abscess could not be found by this means. For some reason improvement followed this insufficient operation but the patient died of a hemorrhage a few months later.

CASE II.—*Bronchiectatic abscess; thoracoplasty; infection of opposite lung. Death.*

I. B., a boy of nineteen was referred to me on August 11, 1911, by Dr. James A. Miller, from his service at Bellevue Hospital.

Eight months before his illness had begun with pain in the right chest, cough and fever. No tuberculosis.

When he came to me he was in good general condition though there was some cyanosis. His breath was very fetid and there was a daily expectoration of eight ounces, the patient often vomiting from his cough.

The pulse was normal, the temperature rising at times to 100°. Over both chests were numerous moist râles but the right base appeared to be most involved. Below the tenth rib posteriorly on the *left* side there was impaired resonance.

A radiograph by Dr. Hirsch disclosed a shadow representing the diseased area in the right chest.

Operation.—On August 17, 1911, at Bellevue Hospital, the patient in ether anæsthesia, I resected two inches or more from the seventh, eighth, ninth, and tenth ribs, my incision being parallel with the border of the latissimus dorsi muscle. The pleura was not violated.

While this operation did not diminish the quantity of sputum, its character changed and became non-odorous and more mucoid. The temperatures ranged about 99° F.

In March, 1912, the patient entered Mt. Sinai Hospital for further treatment because of repeated severe hemorrhages.

An X-ray picture at this time showed some clearing of the former shadow but there was opacity in the right base up to the ninth vertebra. The general condition and weight had improved greatly after the operation but had then deteriorated. Expectoration about four ounces a day.

On April 12, 1912, I removed large sections of the second, third, fourth and fifth ribs in the axillary line, the anæsthetic being ether administered by intratracheal insufflation. The patient's color remained excellent during the anæsthesia, but directly afterward there was deep cyanosis continuing for some hours. For about two weeks there seemed to be improvement but the left lung became acutely infected and he died on May 16. Unfortunately no autopsy.

Critical Note.—Another discouraging case. The question comes up as to the possible influence of the intratracheal insufflation in the appearance of the acute process in the left lung, although it must be borne in mind that this lung was far from normal from the beginning. Still, the second operation under the insufflation was no more severe than the first in ordinary anæsthesia. Perhaps the tube was too large in spite of its careful selection. That injury to the lung can occur from intratracheal insufflation is well known, though a proper sized tube and attention to details of pressure with periodic collapse of the lungs should make the accident a rare one.

CASE III.—*Bronchiectatic lung abscess; resection of ribs and attempted drainage.* G. R., thirty years old, had been sick for nine weeks with pain in the right upper chest, cough, profuse and extremely fetid expectoration, fever, vomiting, one chill, and night sweats. There had been much loss of weight and three slight hæmoptyses.

He was referred to me by Dr. James A. Miller, who stated that the case was very probably non-tuberculous, a number of sputum examinations having been negative.

The blood showed 18,000 leucocytes with 90 per cent. polymorphonuclears.

On February 6, 1912, he was admitted to Mt. Sinai Hospital.

There was fetid expectoration amounting to about 200 c.c. in twenty-four hours. Cough and expectoration occurred at once when the patient lay upon his left side. There was dulness in the right posterior chest from about two finger breadths below the angle of the scapula. Prolonged expiration at the upper level of the dulness with harsh breathing and coarse sonorous and sibilant râles below this point.

Radiography showed an opacity in the right upper chest reaching almost to the apex of the right lung but not entirely obliterating the normal transparency at this point. The opacity was as large as an adult human palm.

Dr. Miller stated that he had aspirated the suspected area and had secured a few drops of thick mucopurulent material.

On February 16, in intratracheal anæsthesia with ether, an incision was made along the border of the latissimus dorsi, beginning almost at the apex of the axilla. Sections of the third, fourth and fifth ribs were removed here and the chest opened. The pleura was free everywhere except posteriorly and the area above indicated where there were dense adhesions. The lung and parietal pleura were united by a running catgut suture, except posteriorly where the adhesions existed. A large aspirating needle was then plunged repeatedly into the indurated mass but failed to reach a pus cavity.

About six days after this operation I punctured the site of the supposed abscess a number of times through the wound. The result was persistently negative. The patient, however, continued to improve, expectoration amounting to less than 200 cubic centimetres in twenty-four hours and there was an increase of seven pounds in weight. On March 20 he was discharged from the hospital, the wound healed. His sputum then amounted to 100 cubic centimetres in the day. He was subjectively and objectively improved.

Note.—There is nothing remarkable about this case unless it be the fact that as in Case I an insufficient operation was followed by unexpected improvement. I proposed further surgery to this patient but he regarded his condition as tolerable and therefore he refused.

Case IV.—*Bronchiectatic abscess; thoracotomy and drainage; multiple rib resection.* On December 17, 1912, this patient, Harry G., twenty-three years old, was transferred from the medical service of Dr. Manges at Mt. Sinai Hospital. He had been ill for six months with cough and profuse foul expectoration—always more abundant in the morning. There had been eight hæmoptyses, much blood being lost each time. There were occasional slight attacks of fever.

On physical examination, there was dulness with hard breathing and inconstant " sticky " râles in the right axilla. The patient had clubbed fingers. His general condition, however, was excellent as to nutrition and musculature.

The temperature was normal, the pulse 80 and the respiration rate 24.

A radiograph made by Dr. Jaches, on December 7, 1912, revealed a sharply defined, oblong shadow opposite the base of the heart, with a prolongation upward and outward. There was also a narrow shadow passing downward and outward (see Fig. 3).

Operation.—On December 20, 1912, in intratracheal anæsthesia, an incision was made parallel to the fibres of the latissimus dorsi muscle in the right posterior axilla. A four inch section of the fifth rib was removed and an attempt was made to enter the pleural cavity. Adhesions all about, however, showed a complete walling off. A section of the fourth rib was removed, also without entering the general pleural cavity, and a needle puncture withdrew a small quantity of fetid pus. A narrow opening was made with the scalpel and then with dressing forceps the extremely tough and dense membrane surrounding the abscess itself was torn apart, the dressing forceps on withdrawal widening the opening into the cavity. Explored with the finger there were evidently many loculi and the case one of bronchiectatic abscess. But little pus escaped at this time. The abscess was very deep and lay next to the anterior chest wall. The entire wound was now packed with gauze and the patient sent back to bed with the intention of subjecting him to further operation at another time. The anæsthesia had been excellent throughout, although some blood and pus had appeared at the patient's mouth during the operation.

Ten days later the patient was anæsthetized in the usual manner with nitrous oxide and oxygen and, in the hope of reaching the bronchiectasis more directly, about two inches of the fourth rib were resected at its anterior inner portion. To my surprise, upon incising the chest at this point I found that I had invaded the free pleural cavity. It was quite clear that the former operation had drained the abscess as far as was possible, so the opening in the pleura was packed and the remainder of the wound was sutured. A tube was later placed in the abscess cavity and suction maintained with the apparatus referred to in Case IX. The patient's condition now improved every day but he still daily expectorated from three to five ounces, the only difference noted being that the discharge was less purulent and more mucoid than it had formerly been.

The wound healed and the patient was sent to a convalescent home. His general health was good but the cough and expectoration for which he sought relief had been influenced but little.

Nearly a year after the first operation this man presented himself again, saying that he was unable to work and that the foul discharge from his lungs made him so miserable that he was willing to submit to anything rather than continue as he was.

On November 21, 1913, in ether anæsthesia by inhalation, I removed sections from the fourth, fifth, sixth, seventh, eighth and ninth ribs through a long posterior incision. The inner bone-sections were made just to the spinal side of the costal angle and the amount resected was about two and one-half inches from each rib. The pleura was not injured. The wound was closed by suture with tube drainage above and below. While hemorrhage had been free it was not near the danger line. The chest wall was thoroughly strapped so as to approximate the cut ends of the ribs and reduce the size of the thoracic cavity.

Another examination of the sputum was negative for tubercule bacilli. A culture by Dr. H. Plotz, of the Pathological Laboratory, showed bacillus mucosus capsulatus and from this a vaccine was prepared and given. Highest dose one billion. The patient thought he noted improvement following this therapy. There was now steady progress but by no means a cure. The patient's general condition was very good and his " emptyings " occurred usually but once a day—in the morning. The discharge was not as foul as it had been and the quantity was seldom more than three and one-half ounces.

The case is not yet finished and I hope to improve his condition still further, perhaps by completing the Wilms's operation, resecting the ribs anteriorly, or possibly by attempting the extirpation of the well localized lung infection.

Because of recent published experiences and because Dr. Yankauer had found and removed an unsuspected foreign body from the bronchiectatic cavity of an old man in one of the medical services at Mt. Sinai, H. G. was bronchoscoped before his discharge from the hospital but nothing was found. The diagnosis of bronchiectasis was, however, confirmed.

A glance at the photograph (Fig. 4) gives an idea of the man's general condition and also shows the degree of deformity produced by the operation. The X-ray (Fig. 5) shows the collapse which was attained.

Note.—I am by no means proud of this result even though it compares favorably with many of those reported in recent literature. If we ever are to accomplish anything like an actual cure in these almost hopeless cases it will be by means of direct surgical attack with the actual removal of the bronchiectatic mass.

CASE V.—*Bronchiectatic abscess; transpleural drainage.* A. S., a woman of twenty-six, had been well until March, 1912, when she had "pneumonia" followed by left empyema for which she had been operated upon in another hospital. She had been sent home "well" but there was a relapse and a discharging sinus persisted. At the time of her first operation she was coughing up enormous quantities of pus.

She entered Mt. Sinai Hospital on April 19, 1913. The left lung was entirely dull and in its lower third flat. There were bronchial breathing and numerous râles.

There was a deep sinus in the posterior axillary line at the level of the eighth rib and when the patient coughed there was a mucopurulent discharge.

X-ray by Dr. Jaches showed in the left chest one homogeneous shadow, denser below.

On May 26, 1913, in ether intratracheal anæsthesia, I made long resections of the sixth and seventh ribs in the postaxillary region but extending far toward the back. A honeycomb cavity fully as large as a man's fist was exposed, the walls lined with sluggish granulations and showing five separate bronchial fistulæ of various sizes. The tough pleura on the costal side was resected and the huge cavity was packed (see Fig. 6).

The patient made rapid improvement and the wound again shrank to a sinus, which was in truth a mere bronchial fistula discharging opalescent mucus when the patient coughed. She was discharged three months after the operation.

Twelve weeks later, November 15, 1913, there was an infection of the sinus with constitutional symptoms. Under suitable dressings the bronchial fistula regained its "normal" condition.

Critical Note.—This case illustrates the futility of expecting a radical cure of these bronchiectatic cavities by ordinary drainage, no matter how perfect. The walls are rigid and the bronchial openings cannot fall together nor do they granulate. I repeatedly tested the various escharotics and the actual cautery through the ample opening, but with no good effect. In another case—perhaps even later in this one—an attempt might be made to dissect out a stump of each bronchus from the wall of the cavity, crush it and ligate in the hope that granulation tissue might then form and lead to a permanent closure.

CASE VI.—*Diffuse pulmonary gangrene; hæmopneumothorax; thoracotomy. Death.* H. A., a man of forty-eight and previously healthy, was seen by me in consultation with Dr. D. H. Davison on October 11, 1913, after two weeks of what had been diagnosed left septic pneumonia. The disease showed no tendency to clear up and the entire left chest was flat to percussion. Aspiration by the attending physician withdrew foul, sanguineous fluid which under the microscope showed no white cells but granular detritus, bacteria and blood pigment with broken down blood-cells. The heart was but little displaced. Patient icteric and septic with pulse 120 and temperature 104°. There was little cough and no foul odor from the mouth.

A few hours later, in local anæsthesia, I resected the eighth rib in the posterior axillary line, evacuating much fluid, clot and fetid gas.

Next day I was able to get a good view of the lung itself which was dry and obviously gangrenous as far as the eye could see. The pleura also was sloughing and a whistling sound within the chest indicated an opening into the lung. The wound remained dry and necrotic, delirium supervened and four days after operation death occurred. No postmortem.

Note.—This case is of interest principally because of the absence of physical signs indicating pneumothorax. The entire chest in all postures was absolutely flat to percussion, yet there was much gas under pressure in the pleural cavity. The character of the aspirated fluid and especially the absence of pus cells led us to diagnose perforation of the lung before operation. I have seen the same noncellular foul sanguinolent fluid in a chest some days after a gunshot injury of the lung. Judging by the great extent of the lung necrosis this case was hopeless from the first.

It was one of those cases, rare on the operating table, in which there was gangrene without suppuration.

CASE VII.—*Acute abscess of the lung; thoracotomy and drainage.* About seven months before admission to Mt. Sinai Hospital, Harry L., forty-one years old, had been seized with a malady accompanied by a severe cough with fetid expectoration, following undue exposure to cold. There was fever and loss of weight. The amount of expectoration was as much as eight ounces in a day. There had been no night sweats.

He was transferred from the medical service of Dr. Alfred Meyer on March 29, 1912, after a residence of several weeks in the hospital. During this time his temperature had rarely risen to more than 100°. Repeated examination of the sputum had failed to disclose tubercle bacilli but there were distinct evidences of pulmonary disease of the upper portion of the left chest.

An X-ray examination on February 7 showed a distinct circular shadow below the left pulmonic apex and apparently nearer the back of the chest than the front (Fig. 7).

About the 22nd or 23rd of March the patient began to have high fever with alternating drops of temperature, but the sputum was still negative for tubercle bacilli and the white blood count was normal. On March 29 Dr. Meyer had aspirated pus through the anterior part of the chest.

The same afternoon under ether administered by the intratracheal insufflation method, I made an incision beginning near the apex of the axilla and running parallel to the border of the latissimus dorsi muscle for about six inches. The serratus magnus was divided at this place. Sections of the third, fourth and fifth ribs were removed over an area the size of the palm of the hand. Careful dissection between mouse-tooth forceps showed that the pleura was intimately adherent to the lung. Aspiration of the abscess was followed by a free opening made with the dressing forceps, the general pleural cavity remaining uninvaded. On digital exploration there was thorough walling off, although from the large quantity of pus expectorated it was most probable that an opening into the bronchus existed. The abscess cavity was irrigated, then lined with a pouch of rubber dam which in turn was filled with gauze. Iodoformized gauze was packed into the external part of the wound and a few sutures were placed in its lower part. During the operation there had been a considerable discharge of pus and mucus from the mouth. The patient was sent back to the ward in good condition.

Although during the next 48 hours the temperature came down, the patient was in a very uncomfortable and serious condition, owing to the gathering of large quantities of discharge in his trachea. This he seemed unable to expectorate, although on observation it appeared that he raised and swallowed the discharge. Periodically the foot of the patient's bed was elevated eighteen inches and he was turned upon his face in the hope that this might facilitate the bringing up of the pus.

Four days after the operation the patient died, evidently of a pneumonic process, probably near the site of the abscess. No autopsy was permitted.

Critical Note.—Apparently a serious secondary infection with putrid abscess had begun when the temperature rose just before the operation. The patient's condition then seemed grave.

One technical error was committed—namely, the irrigation of the abscess cavity. It has been pointed out by Garré and Quincke that this procedure is particularly hazardous because of the danger that septic fluids may enter bronchi which until then have escaped or that the infection may even run over into the healthy lung. And it appears to me that even with the advantage of intratracheal anæsthesia fluid introduced in great quantity, as by irrigation, may not be blown out of the mouth quickly enough to prevent extensive septic flooding.

CASE VIII.—*Acute abscess of the lung; thoracotomy and drainage.* Miss E. B., twenty-four years old, had been well until September 24, 1912, when she had an attack of what was called " la grippe." The most annoying symptom was pain in the external anterior part of the right chest at about the level of the third or fourth rib, and this point was also very tender to the touch. For four weeks the patient ran an irregular temperature, the pain and tenderness persisting.

I saw her with her physician, Dr. Manges, on October 12, in the Private Pavilion of Mt. Sinai Hospital. Aspiration had been performed a few days before when a little slightly clouded serum had been withdrawn. Subsequent aspiration was, however, negative. A Röntgen picture suggested fluid to the level of the seventh or eighth rib in the right chest (Fig. 8). The patient's condition was wretched. There was mucopurulent, blood-tinged expectoration, cyanosis and dyspnœa.

In nitrous oxide and oxygen anæsthesia, I aspirated repeatedly in the posterior axillary region but with negative result. I then made an incision parallel to the border of the latissimus dorsi muscle and removed generous sections of the eighth and ninth ribs, opening the pleural cavity for inspection. There was no fluid and there was but one firm, dense adhesion binding the lower lobe anteriorly to the chest wall. Otherwise, although the right lung appeared to be covered with a rather thin layer of greyish membrane, there were no adhesions.

The peculiar greyish appearance of the diaphragm was so remarkable that I excised a minute piece of it under the impression that its examination might prove useful. The muscle was, however, so extremely thin that the tiny opening spread until it was fully as large as a dime. I closed this by a single mattress suture. The chest wound was now also closed, a piece of gauze being left as a packing down to the adhesion. At the end of the operation it was found that the patient had had a considerable discharge of blood from the mouth.

There was a decided improvement in the general condition following this merely exploratory procedure and the wound healed kindly without the occurrence of intrapleural suppuration. The pain in the anterior chest, however, did not disappear and cough and expectoration continued. The temperature rarely rose now to a point beyond 101°. There was considerable improvement in nutrition.

About the tenth of November a point of induration was noted just beneath the right mamma, and four days later, in nitrous oxide anæsthesia, a long incision was made in the inframammary fold and pus was encountered here outside of the chest itself. The mamma was turned up off the chest wall and the origin of the flow of pus was found in the nipple line just below the fifth rib. A section of this bone was removed and the finger could easily explore a sponge-like abscess about 30 c.c. in extent. A tube was put in as a drain and the submammary exposed space was lightly packed with gauze.

Convalescence from the operation was rapid and the patient was discharged from the hospital in a month. A few weeks later healing was complete. The inframammary cicatrix was most unobtrusive.

Note.—In the case just reported the exact diagnosis was in doubt. Referring to the radiograph (Fig. 8.), the straight horizontal limit of the right chest shadow strongly suggested fluid level—yet this appearance must have been caused by something else unless we can imagine that an extremely thin layer of liquid exudate could have caused it. Comparing the density of media in the two " clear " parts of the chest there is no hint of compression on the right side such as we might have expected had fluid forced the lung upward.

My first operation was truly an exploration and it accomplished the localization of the abscess and gave knowledge as to the extent of the adhesions, so that at the second step I resected rib without fear of invading the uninfected part of the pleural cavity. I have since made use of this double operation with success.

CASE IX.—*Abscess of the lung complicating paratyphoid fever; thoracotomy and drainage.* On December 22, 1912, N. S., a man of twenty-two, was transferred from the Rockefeller Hospital to Mt. Sinai Hospital with a diagnosis of empyema in the course of paratyphoid fever.

The history abstract stated that he had also been treated at the Rockefeller Hospital for what appeared to be a complicating lobar pneumonia. He had been aspirated in the seventh interspace at the right scapular line and 20 c.c. of thick, greenish pus had been obtained.

On examination there was dulness below the fourth rib anteriorly and beneath the level of the eighth dorsal spine posteriorly. Breath sounds over the flat area were diminished or absent. Fremitus was increased.

The white blood-cells were but 10,200, the temperature was 101°, the pulse 100 and the respiration 24.

The patient still suffered from his paratyphoid infection and was acutely ill.

On the following day he was anæsthetized with nitrous oxide and oxygen and I resected the seventh rib where it crossed the border of the latissimus dorsi muscle. Before making the incision aspiration was practised and only on very deep puncture toward the base of the chest was pus obtained. Entering the chest after the rib resection there was no fluid and there were no adhesions, except of the right lower pulmonary lobe to the diaphragm and outer chest wall. Under the guidance of the eye an indurated place in the right lower lobe was aspirated and pus obtained. It was then determined not to evacuate the abscess at this sitting. Instead, a portion of the eighth rib was also excised so as to make the opening into the chest ample. Gauze packings were put in so as to cause the formation of adhesions between the parietal and visceral pleuræ above the abscess, with a view to evacuation at a second sitting.

Four days later the patient was again taken to the operating room and without anæsthesia the central packing, which went down to the abscess, was removed, leaving the "walling off" packing undisturbed. The opening was large enough to permit of aspiration with the aid of sight through the very thick firm-walled abscess and pus was again obtained. The scalpel was now carried down to the point where the needle entered the lung and the abscess wall, tough and almost cartilaginous in feel, was incised and the opening enlarged with dressing forceps, but the fluid was evidently not under very great tension and it was not until the patient was turned upon his side that a large quantity of extremely foul and thick pus poured out in a syrupy stream. A large sized drainage tube was carried several inches into the cavity which was irrigated and new packings were placed around that part of the tube between the thoracic wall and the actual opening of the abscess.

The culture from the laboratory was reported "streptococcus" (examined by Dr. P. Aschner).

On January 8, 1913, twelve days after the evacuation of the abscess, the last of the walling-off packing was removed, much force being required to detach it from the pleural adhesions. Now local improvement set in but the constitutional symptoms were still severe, the temperature often reaching 105°. The wound was apparently divided into two parts, the first being virtually an encapsulated empyema, the actual lung abscess being entered by an opening just about large enough to fit the tube and this opening was almost a finger's length from the surface. On account of the very great rigidity of the abscess walls drainage was not easy. The patient was now transferred to a bed on the roof and a suction apparatus was improvised with the aid of a vacuum cleaner and a bottle for collecting the discharge. This was kept going day and night and I believe contributed greatly to the comfort of the patient and to his convalescence. The wound was healed in the latter part of April and the patient was sent to a convalescent home in the country. He gained rapidly in health and strength, although his cough was slow in disappearing. In June the cicatrix broke down and discharged for a few weeks but closed spontaneously and the man has remained in excellent health ever since.

Note.—In spite of the history of pneumonia and the careful examinations made by the Staff of the Rockefeller Hospital, it appears to have been impossible to make an accurate pre-operative diagnosis in this complicated case. The suspected empyema turned out to be a lower lobe abscess and though there was no sign of subphrenic suppuration before operation it may well be that an infection of this kind existed with slow boring of pus into the chest and into the adherent lung on its way toward a bronchus whence, had the patient's strength held out, evacuation through the mouth might have resulted.

Drainage by the use of the vacuum cleaner surely benefited this man—and for some days the same device with two tubes sufficed to empty the abscess of H. G. (Case IV), the one machine doing double duty. I now make use of a special suction pump devised by an instrument maker. This apparatus consists of an electric pump, a vacuum tank and a gauge for regulating the suction power. The pump acts intermittently, ceasing when the required vacuum in the tank has been secured and starting automatically when necessary to keep up the requisite exhaustion of air. The machine is quiet and requires but little attention.

A case of interest in comparison with that of N. S. is here recorded.

Case X.—A. M., thirty-five years old, a physician, was referred to me by Dr. James A. Miller, on January 8, 1913.

One year before he had been operated upon for chronic appendicitis. There had been primary union but at the end of a week he had what was called "paralysis of the bowels." He was up and about six weeks after the operation but he walked with his body bent to the right. Suddenly he coughed up a large amount of pus. Ever since then he had had attacks of coughing and raising mucopus sometimes with blood, the whole never amounting to more than four ounces in a day. Occasionally a whole month would pass without cough. When the abscess filled he had fever.

A radiograph made by Dr. Lewis Gregory Cole is here reproduced (Fig. 10). Quoting in part from Dr. Cole's report, "There is a thickening around both roots and one of the branches of the right descending bronchi. There is consolidation of the lower part of the right lung obliterating the costodiaphragmatic angle, or the lung may be displaced upward by an accumulation of fluid in this region. The thickening along the branch of the right descending bronchus indicates that this is the route by which this abscess cavity empties. The thickening around the root on the opposite side indicates that there is a slight infection in this region. There is no evidence of any other abscess in the parenchyma of the lung."

Considering the patient's condition, which was not bad, and the fact that he would go sometimes as long as a month without a discharge from the abscess and without fever, I suggested that a culture should be made from the sputum with a view to autogenous vaccine therapy. A pure streptococcus strain was found at the Sondern Laboratory in June and fifteen injections were taken. On October 21 the patient presented himself looking well. He stated that there had been but one slight attack in four months.

I believe that the prognosis in this case is favorable for a final complete obliteration and cicatrization of this suppurating cavity.

CASE XI.—*Abscess of left lung, upper lobe; thoracotomy and drainage.* The unusual case of V. H., a boy of twelve, is interesting. He had been for some weeks under the observation of Dr. Koplik and had entered Mt. Sinai Hospital late in December, 1912. The history was one of left pneumonia in infancy; tonsils and adenoids removed in 1910. A few months prior to admission he had had a pneumonia and this was followed by chronic cough and an occasional hæmoptysis, with pain in the left chest.

The boy looked pale and thin. There was clubbing of the fingers. Physical examination of the lungs showed, posteriorly, dulness at the left apex to a finger's breadth below the spine of the scapula. Anteriorly and in the upper axilla there was dulness.

The dull areas showed bronchial voice and breathing with subcrepitant râles over the left supraspinous region. Bronchovesicular breathing over the left interscapular region.

The blood count: white cells, 15,000; polynuclears, 54 per cent.; small lymphocytes, 27 per cent.; large lymphocytes, 16 per cent.; transitionals, 1 per cent.; eosinophiles, 2 per cent.

Neither the sputum nor the Von Pirquet test gave evidence of tuberculosis.

On December 21, 1912, pus was obtained by aspirating in the left armpit, the needle pointing upward and backward.

Operation.—On January 2, 1913, in ether anæsthesia, an incision was made from the middle of the clavicle downward two and a half inches, dividing some of the pectoralis fibres. About three-quarters of an inch of the second rib was resected, the aspirating needle forced through the thick, almost cartilaginous, tissues and the abscess opened widely with director and dressing forceps. About three drachms of thick, foul pus were evacuated and tube drainage instituted.

Below and to the outer side of the abscess walls normal pleura could be seen moving with respiration.

For two weeks the case went smoothly and the patient improved, the cough diminishing. Then came fever and pain in the wound. Aspiration and digital examination failing to disclose the cause of the continued fever, cough and slight hæmoptysis, the patient, on January 24, 1913, was once more anæsthetized and, guided by a finger in the wound, a needle was passed through the posterior wall of the cavity where a few drops of thick foul pus were obtained. A dressing forceps following the needle was pushed through until its blades could be felt beneath the skin just above the scapula and here a second incision was made. A large drainage tube was drawn directly through the apex of the lung, from back to front. Improvement went on from this time, though progress was interrupted by occasional fever. Fifteen days after the last operation the tube was replaced by three strands of thick silk. Ten days later the silk was withdrawn and the tract filled with Mosetig-Moorhof's iodoformized wax. About three months after the first operation the boy was discharged recovered. He has continued in excellent general health, does not cough and has become big and strong. He has even " grown up to " his clubbed fingers, the deformity having almost disappeared (see Fig. 11).

Critical Note.—Surgically speaking, this was a case of lung abscess. Dr. Koplik regarded it as one of apical empyema, but whether or not the case began in the pleura the suppuration was anatomically in the lung, as shown by operation and by the expectoration of pus and by the hæmoptyses. I do not regard it as primarily bronchiectatic but as an abscess caused by pulmonary necrosis in the course of a pneumonia, bronchiectasis perhaps occurring secondarily. The extremely dense, tough wall about the pus sacs—at least two in number—is suggestive of "indurative bronchiectasis."

Case XII.—*Fetid bronchitis mistaken for chronic abscess of the lung; extrapleural tamponade with paraffin* (*Tuffier*). The patient, J. P., was a man forty-two years old. His disease began with cough, slight fever, profuse mucopurulent expectoration and night sweats with loss of weight. Sometimes he vomited after a severe coughing spell. There developed pain in the right chest and the odor of the sputum became foul. The temperature gradually rose until it reached 104° with the pulse rate varying between 96 and 120. Two weeks after the onset he entered Mt. Sinai Hospital on the medical side. This was on August 8, 1913.

The physical examination of the lungs at that time showed dulness with diminished breathing in the right axilla. Posteriorly, on the right side there was dulness from a point two fingers breadth above the angle of the scapula down to the base, with diminished vesicular breathing and diminished fremitus accompanied by noisy crepitant and subcrepitant râles.

The blood count showed 18,800 white blood-cells with 75 per cent. polymorphonuclears, 24 per cent. lymphocytes and 1 per cent. eosinophiles.

The sputum was very abundant, pale yellowish-green and persistently negative for tubercle bacilli.

On August 15, 1913, and again on the 29th an X-ray examination was made by Dr. Jaches. The report stated that the right apex showed slight density with infiltration of the root of the lung and with bronchial nodes. At the right base there was a dense infiltration continuous with that of the right lung. The right diaphragm was high (Fig. 12).

The findings on fluoroscopy indicated the presence of fluid in the right costophrenic space. The diaphragm on that side was fixed.

The patient was kept under observation for a number of weeks, occupying a bed in the open air on the roof and in excellent hygienic surroundings. There was, however, no improvement—rather a retrogression, although the general condition remained good.

There appeared to be two kinds of sputum; the one not foul, the other extremely fetid. The amount gradually increased until on November 6, 750 c.c. in twenty-four hours were discharged.

Early in November, the patient was examined by Professor Tuffier of Paris, and his case was pronounced a suitable one for the operation of extrapleural compression.

Some days later bronchoscopy was performed in local anæsthesia by Dr. Yankauer. At this time there was no sign of bronchial dilatation nor was there at the time of the bronchoscopy any discharge of foul pus. Dr. Yankauer, therefore, concluded that probably there was a parenchymatous lung abscess communicating with a bronchus, and he believed that at the time of the examination this communication must have been plugged.

On November 7, 1913, in ether anæsthesia administered by the intratracheal method, I made an intercostal incision between the eighth and the ninth ribs through the endothoracic fascia to the pleura, which was then separated digitally from the chest wall without opening the sac itself. This peeling away of the pleura was done as Tuffier advises—very slowly and carefully. It was not a difficult procedure. The ribs of this patient, however, were very close together and I wished to avoid the long intercostal incision. In order to gain more space I resected about four inches of the eighth rib. There was finally a cavity formed which I judged to be about 400 c.c. in size. During this procedure there was a discharge of extremely foul pus from the patient's mouth.

Paraffin, with a melting point between 105 and 108° F., was then put in—about 300 c.c. in all. I began with the paraffin in the liquid state but this was unmanageable, since it did not solidify quickly enough to prevent its being expelled and, therefore, pieces of soft solid paraffin were eventually employed. The patient stood this operation well although his pulse rose to 105°. The wound was closed without drainage.

The immediate result of the operation appeared to be favorable. The patient expectorated much less than before, but on

November 10, on examining the wound there was much bulging and on separating the edges a large quantity of turbid serum escaped. The patient then gradually deteriorated and the septic manifestations became progressively worse.

On November 19 I was obliged to reopen the entire wound without anæsthesia and I removed the paraffin, packing the cavity lightly with gauze. Two days later, also without anæsthesia, I aspirated the lung hoping to find the abscess but without success. Death from his septic chest condition occurred on November 28.

An autopsy through the wound was performed by Dr. Baehr and this brought forth some interesting and suggestive disclosures.

At the site of the operation and, in fact, over the entire right base the visceral and parietal pleuræ were densely adherent. There was found not a single large collection of pus in the lung but in each lower lobe there were eight or nine small abscesses, most of them from one to two centimetres in diameter and lined by pyogenic membrane. The bronchi to both lower lobes and some to the upper showed intense congestion of the mucous membrane and in some places hemorrhage. All the bronchi were filled with thick, greyish-white purulent material. In addition to the abscesses there were some small areas of grey hepatization and small areas of gangrene, particularly in the right lower lobe. The latter as well as many of the abscesses were peribronchial in distribution. In the left lower lobe there were numerous small areas of purulent bronchopneumonia.

I will now quote from the microscopical examination:

"There is a marked thickening of the pleura from which fibrous bands run into the lungs. The walls of some of the bronchi are infiltrated with polynuclear and round-cells. Many of the small abscesses can be definitely seen to have their origin in and about a small bronchus. In addition to the presence of small purulent foci some of the portions of the lung are seen to be completely necrotic."

The bacteriology showed the presence of diplococci, probably pneumococci, some streptococci and an abundance of Gram-positive and Gram-negative bacilli.

All the time that we thought we were dealing with a bronchiectatic abscess or some other form of lung abscess the disease was in reality a presumably incurable septic fetid bronchitis with its sequelæ of suppuration and necrosis in the lung itself. And this particular error is one which has often been made. (Garré and Quincke.)

The case just reported was one in which there was a complete agreement in the diagnosis among all those who saw the patient clinically. He was supposed to be suffering from "bronchiectatic abscess of the right lower lobe." Yet the bronchoscopy changed all this, for no bronchiectasis was discovered. The case then, in view of the two kinds of sputum, began to look like one of extrabronchial abscess and, indeed, the post-mortem findings showed this in measure to be true, though there was no actual fistulous connection between one large abscess and a bronchus. The infection of the operative field is also hardly to be wondered at, remembering the close adhesion of the septic lung with the parietal pleura.

The misreading of the X-ray plates is an old story; and nowhere can one be misled more easily than in the diagnosis of intrathoracic conditions.

In a recent case which was in the service of a medical colleague signs pointed to a subdiaphragmatic abscess with lung fistula and the radiograph showed a high right midriff dome. The patient had expectorated eight ounces of foul pus in one gush. His condition was critical. Tenderness and a mass in the right upper abdominal quadrant led me to incise here and I quickly emptied a gangrenous gall-bladder. Still the X-ray would not permit the idea of subphrenic disease to be put aside. At a careful post-mortem examination there was no subphrenic abscess, no liver abscess, no lung abscess! I have, indeed, come to the conclusion that a high diaphragm often signifies a relaxation or paralysis of this muscle in nature's effort to reduce pressure upon inflamed organs, and that its existence is by no means pathognomonic of an exudate beneath.

CASE XIII.—*Suppurative bronchiectasis; removal of right lower pulmonary lobe.* Francis W., at two and three-fourths years of age, had fallen while he was holding some partially masticated nut in his mouth and, in the gasp which followed or accompanied his fall, some of the foreign material was aspirated into the lungs. There developed cough of a spasmodic nature, with the expectoration of much purulent mucus.

With the aid of the bronchoscope, Dr. Yankauer had succeeded in removing much of the foreign matter and was finally unable to discover anything more within the visible part of the lung. Bronchoscopy was performed six or seven times during the following year. Still the cough and expectoration continued and now fever and rapid pulse were also observed, the temperature reaching as high as 105° and fluctuating at this high level for several days at a time with remissions between.

An X-ray picture by Dr. Jaches showed opacity at the right base which extended up to the eighth rib (Fig. 13).

The child now entered the surgical department of Mt. Sinai Hospital. He was well nourished but pale and apathetic. There was very marked clubbing of the fingers and toes (Fig. 1). The usual signs of consolidation were found at the right base. The spasms of coughing with the ejection of large quantities of foul mucopus were most painful to watch.

Three times after admission to the Hospital he was bronchoscoped by Dr. Yankauer, and after each bronchoscopy with the clearing out of the cavity there was a remission in temperature. Judging by the amount of discharge at each emptying I had some hope that a Tuffier extrapleural tamponade might tend to improve the drainage in this case and, therefore, on January 23, 1914, in ether anæsthesia by the intrapharyngeal method managed by Dr. Branower, I made a long incision between the eighth and ninth ribs down to, but not through, the pleura. In order to get more room without making too long an incision I resected a part of the ninth rib and by digital separation I made a cavity about 40 c.c. in size. Into this I placed three pieces of fat from the abdominal wall of another patient and closed the wound without drainage. No improvement followed this procedure, the coughing spells and expectoration remaining about the same. For a few days the temperature remained in the neighborhood of 100° and then there was a sharp rise to 104° with corresponding constitutional symptoms. The wound was slightly infected and slow in healing.

A month later, February 27, 1914, a minute sinus remained. The child's condition, however, was such that something radical had to be done.

Another bronchoscopy by Dr. Yankauer enabled him to see all the bronchial openings but the picture was practically unchanged. Dr. Branower again managing intrapharyngeal ether anæsthesia, I made a long incision above the eighth rib into the pleural cavity, spreading the ribs wide with retractors. The exposure was perfect. The two upper pulmonary lobes were apparently normal, of the usual yellowish-pink color of a child's lungs. The lower lobe, however, was liver color and of a firm consistency. The piece of implanted fat was in position and apparently alive. There were dense adhesions of the lower lobe to the diaphragm and to the lateral costal pleura. All adhesions were quickly and rather roughly freed with the finger so that it was possible to place a strong double ligature of chromicized catgut completely around the hilum of the lower lobe after having crushed the part with a powerful clamp. The lobe was then cut away. A slight oozing from the stump led me to transfix once more and to ligate again double. The stump was then carbolized, salt solution was placed within the thoracic cavity, a piece of gauze was laid against the raw surface of the stump and led out of the posterior angle of the wound and another little piece of gauze was placed in the original sinus. The ribs were then approximated with chromicized catgut by the pericostal method. A continuous suture of fine chromicized gut was used to hold the intercostal structures together and the cutaneous incision was sutured with fine silk. At the end of the operation the patient's pulse was about 150 but of good quality. The color which had been slightly cyanotic during the greater part of the operation became normal. Reaction was prompt and in less than an hour after the operation the boy was wide awake and crying. The hemorrhage had not been severe, most of it coming from the peeling away of the adhesions.

A careful examination of the lobe which had been removed showed that all the bronchi were dilated and turned into what might be called abscess cavities. There was no trace of a foreign body.

The first twenty-four hours after the operation the temperature did not rise higher than 101°. The patient's condition was good, pulse about 140, very little cough, no expectoration. Then there was a rise to 103° the pulse reaching the alarming rate of 200. The wound was at once dressed, a little superficial suppuration found and all skin sutures removed. The gauze at the posterior angle of the wound was loosened and there was a discharge of turbid fluid, probably a mixture of salt solution and pus. A tube was slipped in alongside the gauze and full stimulation was ordered. The hæmoglobin a few days after operation was, to my surprise, 75 per cent. though the little patient looked very anæmic. Very gradually there was improvement, for two weeks, the child being in a serious condition, the pulse causing especial anxiety on account of its great rapidity.

About a week after the operation mechanical suction apparatus was fitted to the tube within the wound and this avoided frequent change of dressing. The patient's appetite remained good throughout.

On March 16, the slough representing the stump of the lung came away.

After this there was steady improvement and the patient, at the present writing, six weeks after the lung resection, is in a satisfactory state of convalescence. A very small opening in the chest is still present but the outlook is most favorable.[1]

Note.—This case demonstrates that bronchiectasis originally caused by foreign body aspiration may persist in an apparently incurable state after the removal of the exciting cause.

The amount of fat put in at the time of the Tuffier's lipotamponade, in view of the later findings, was absurdly small. But judging by the appearance and size of the bronchiectasis as seen after the resection I doubt that enough fat could have been transplanted to cure the patient.

The cause of the tachycardia is somewhat obscure. Whether it was a septic phenomenon or whether, perhaps, it had to do with the changed pulmonary circulation it would be hard to say. Dr. Koplik, who saw the case in consultation, advised us to give digitalis and under this drug the pulse rate was certainly favorably influenced.

CASE XIV (Unfinished).—*Bronchiectasis; thoracotomy and drainage.* Louis G., thirty-three years old, was admitted to Mt. Sinai Hospital on February 26, 1914. He had been a patient of Dr. Mannheimer.

Four years before he had had pneumonia followed by empyema for which he had been operated upon. For three years he remained well then began to cough and expectorate large quantities of mucopurulent material. There were occasional marked hæmoptyses. The daily amount of expectoration was eight ounces. The patient was altogether miserable and unable to work. He had lost weight and strength.

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[1] At the time of proof-reading, May 10, 1914, the boy is perfectly well.

On admission, a cicatrix representing the former operation was seen in the posterior axillary line over the ninth rib which apparently had been resected. The general condition of the patient was good. The lungs anteriorly were negative and the right lung was also negative posteriorly. On the left there were signs representing consolidation from the left scapula to th base. There was clubbing of the fingers.

An X-ray picture showed an infiltration of the left base with what seemed to be a pulling of the cardiac apex to the left by adhesions.

About March 5 the patient was bronchoscoped by Dr. Yankauer. This bronchoscopy was rather unsatisfactory, owing to the extremely poor anæsthesia and the rigidity of the patient's neck which made it difficult to introduce the instrument. Dr. Yankauer failed to demonstrate a bronchiectasis but thought that he saw granulation tissue in the bronchial walls.

On March 11, 1914, in intratracheal ether anæsthesia, I incised one space above the old cicatrix and to my chagrin passed through the diaphragm and into the abdomen. The peritoneal opening was at once sutured and the chest entered in the seventh interspace with wide resection of the seventh and eighth ribs. There was a mass of pleuritic adhesions, the lung also being adherent to the chest wall so that twice it was injured and had to be sutured. A needle puncture now permitted the aspiration of a few drops of foul, thick pus and in the posterior part of the wound near the angle of the rib I opened into the now empty bronchiectatic sponge. The cavity, about 50 c.c. in bulk, was packed with gauze and part of the cutaneous wound closed with drainage. Considerable distress followed the operation, with cough, temperature 103° and bloody expectoration.

To-day, April 10, the patient's condition is improved and the wound is healing rapidly. He still expectorates from one to two ounces daily and his complete cure without further operation is doubtful.

TABLE OF OPERATIVE CASES RECORDED.*

Case No.	Name.	Age.	Sex.	Date.	Disease.	Type of operation.	Anæsthesia.	Post-operative days in hospital.	Immediate result.			Remarks.
									Cured.	Improved.	Died.	
1	B. F.	55	M	Feb. 21, 1910	Bronchiectasis	Exploration	Insufflation ether	27	...	1	...	Died one year later of pulmonary hemorrhage.
2	I. B.	19	M	Aug. 17, 1911	Bronchiectasis	Thoracoplasty	Inhalation ether	42	...	1		
2	I. B.	20	M	Apr. 12, 1912	Bronchiectasis	Thoracoplasty	Insufflation ether	34	...	...	1	Infection of the other lung.
3	G. R.	30	M	Feb. 16, 1912	Bronchiectasis	Thoracoplasty	Insufflation ether	32	...	1		
4	H. G.	23	M	Dec. 20, 1912	Bronchiectasis	Thoracoplasty and drainage	Insufflation ether	60	...	1	...	Opening into bronchiectasis closed spontaneously.
4	H. G.	24	M	Nov. 21, 1913	Bronchiectasis	Large thoracoplasty (posterior)	Inhalation ether	90?	...	1	...	Improvement but condition still unsatisfactory, 3 to 4 ounces of sputum per day.
5	A. S.	26	F	May 26, 1913	Bronchiectasis with fistula	Free drainage by rib resection	Insufflation ether	90	...	1		
7	H. L.	41	M	Mar. 29, 1912	Acute abscess	Thoracoplasty and drainage	Insufflation ether	4	...	...	1	
8	E. B.	24	F	Oct. 12, 1912	Acute abscess	Exploratory thoracotomy	Gas and oxygen by inhalation					
8	E. B.	..	..	Nov. 14, 1912	Acute abscess	Second stage thoracotomy and drainage	Nitrous oxide inhalation	62	1	...	...	Patient remains well to date.
9	N. S.	22	M	Dec. 23, 1912	Acute abscess	Thoracotomy and drainage	Nitrous oxide and oxygen	120	1	...	...	Patient well to date.
6	H. A.	48	M	Oct. 11, 1913	Pulmonary gangrene	Thoracotomy and drainage	Local	4	...	...	1	Hopeless from the beginning.
11	V. H.	12	M	Jan. 2, 1913	Chronic abscess of apex	Thoracotomy and drainage	Ether inhalation	88	1	...	...	Through drainage, supraspinous region to front of chest.
12	J. P.	42	M	Nov. 7, 1913	Fetid bronchitis	Extrapleural tamponade (Tuffier)	Insufflation ether	21	...	...	1	Case mistaken for bronchiectasis.

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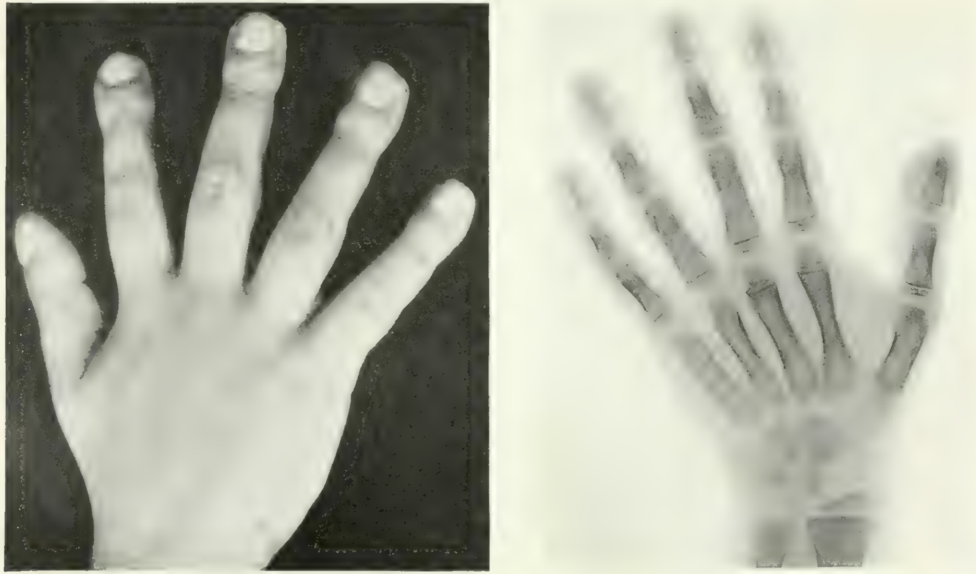
* CASE XIII, unfinished at time article was read, is now complete and adds one more cure. See history in body of text.

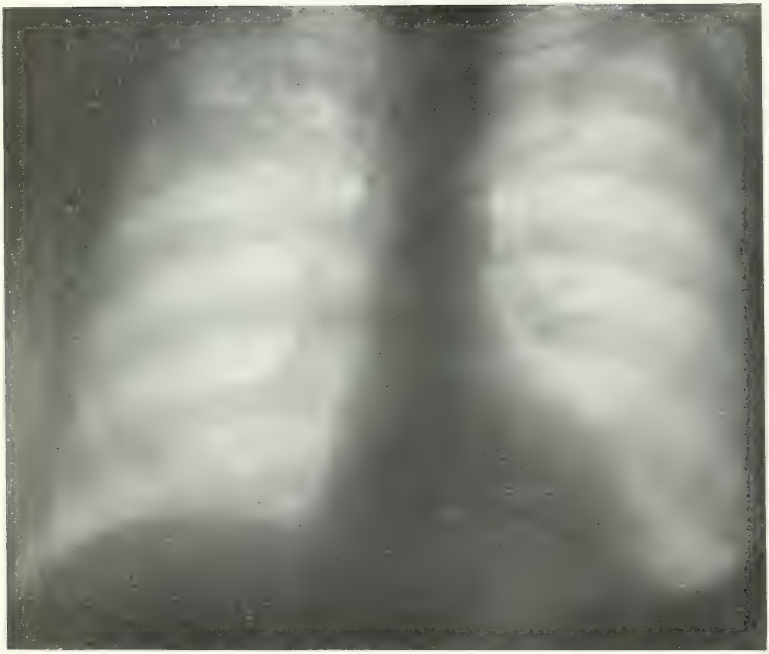
Fig. 1.



a. *b.*

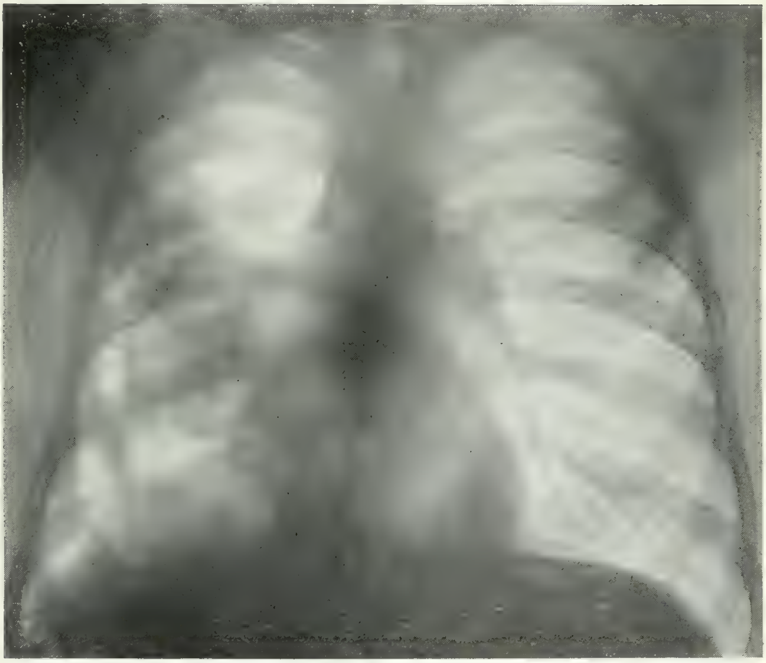
Photograph and radiograph of hand of F. W., Case XIII. Clubbing of fingers with no visible change in the bones.

FIG. 2.



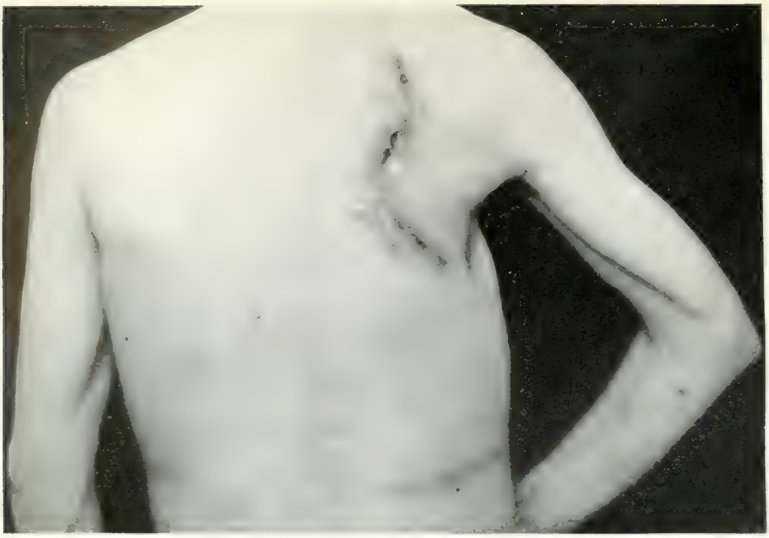
Abscess partly filled with fluid. Note line of liquid level. Right upper lobe. (This patient was not operated upon.)

FIG. 3.



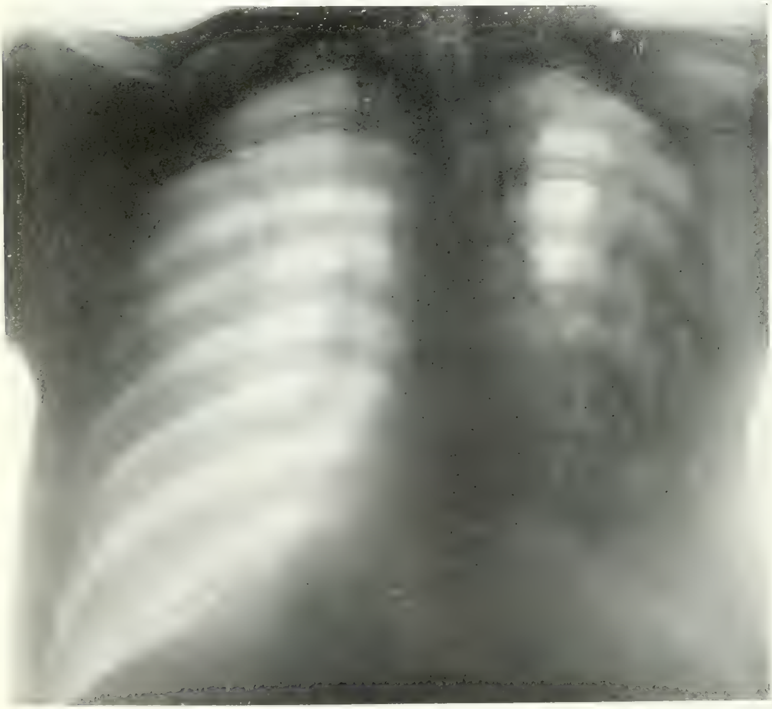
Anterior radiograph demonstrating extent of bronchiectatic mass. Compare with Fig. 5.

FIG. 4.



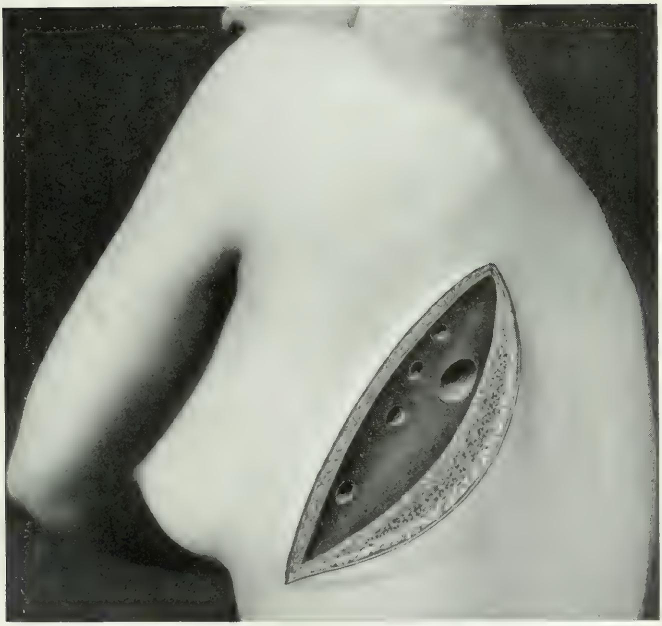
Case IV. Result of posterior thoracoplasty. Compare with Fig. 5.

FIG. 5.



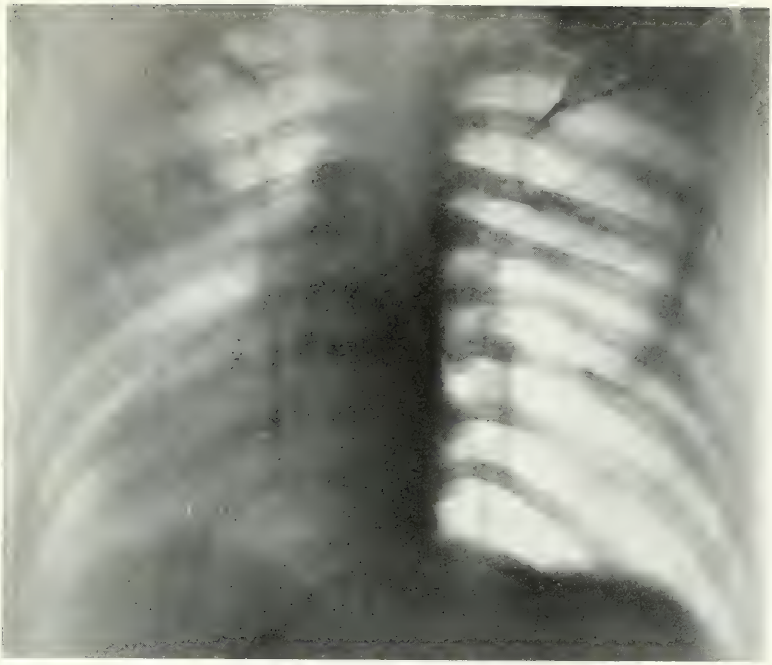
Posterior radiograph showing reduction in the capacity of the right chest following thoracoplasty. Case IV.

Fig. 6.



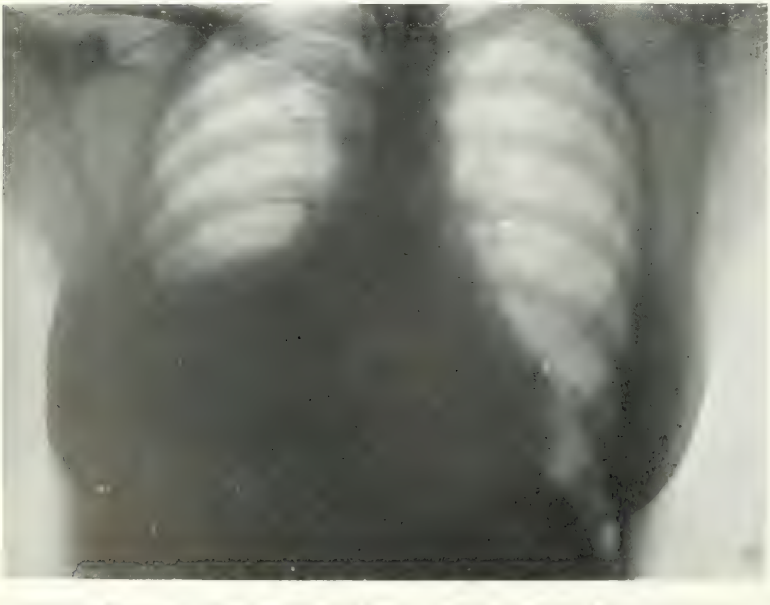
Drawing from sketch Case V. Note the size of the wound and the five bronchial openings. Even this thorough drainage did not result in cure.

Fig. 7.



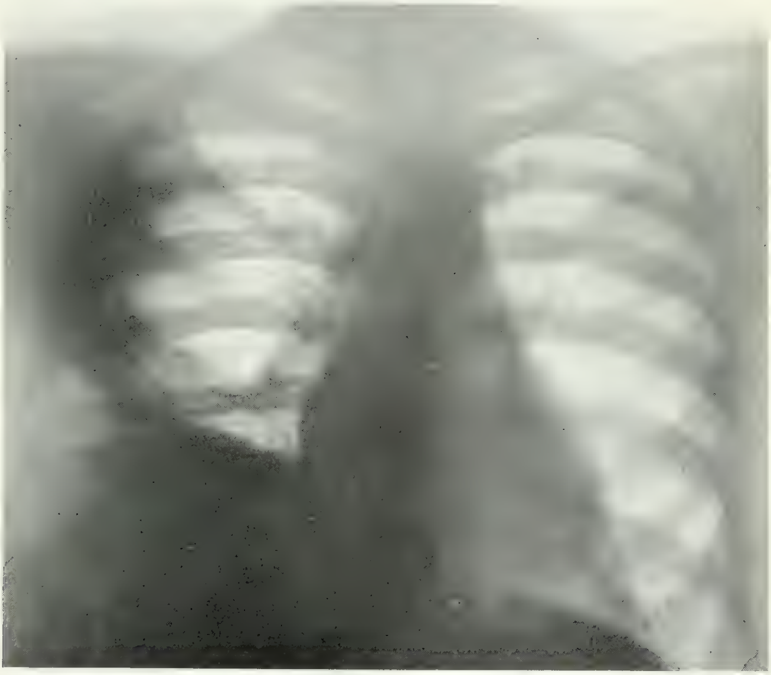
Posterior radiograph. Putrid abscess of left upper lobe. Case VII.

Fig. 8.



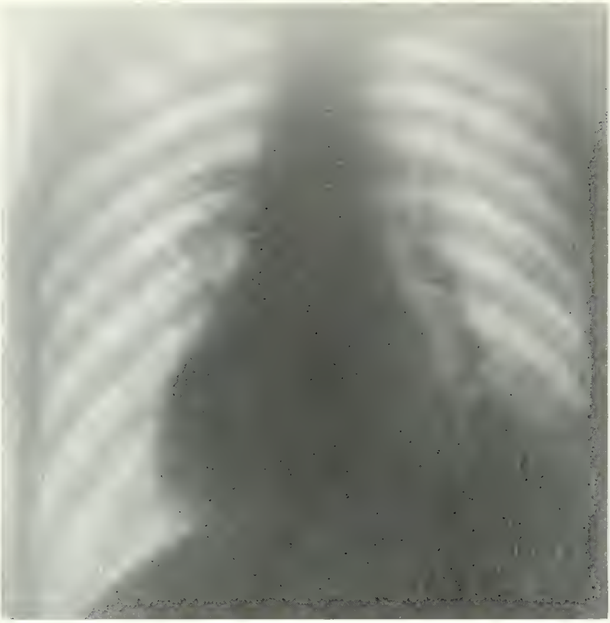
[illegible] Note no [illegible] level. There was no free fluid in this chest. Case VIII. Miss E. B.

FIG. 9.



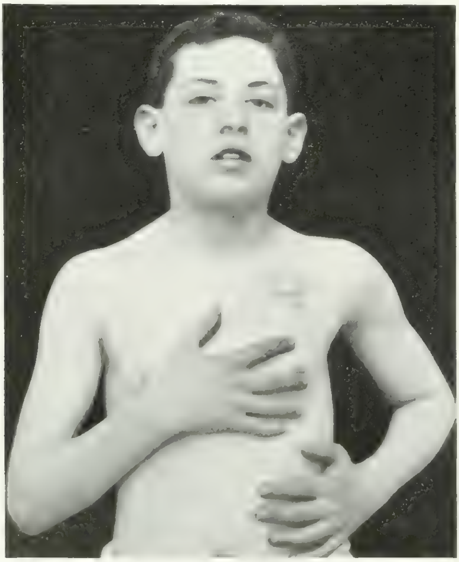
Case IX. Large putrid abscess right lower lobe. Probably from a subdiaphragmatic source.

Fig. 10.



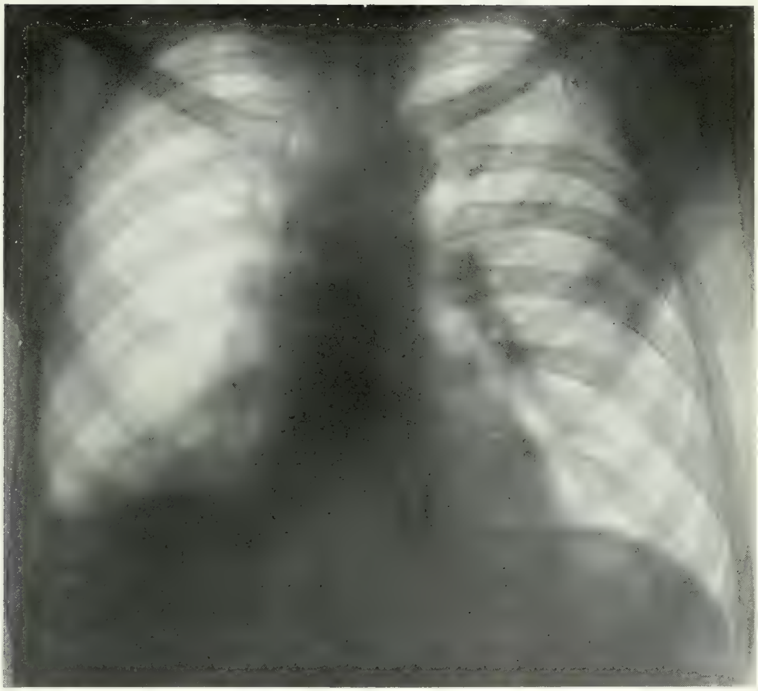
Case X. Showing opacity in right chest probably indicating course of subdiaphragmatic abscess to a bronchus.

Fig. 11.



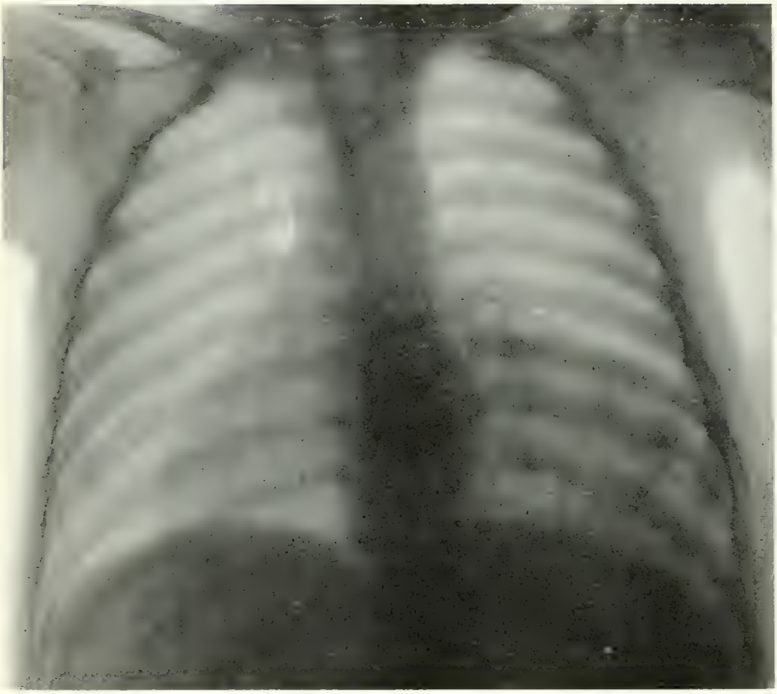
Photograph showing patient recovered after drainage of apical abscess. Clubbing of the fingers no longer present.

Fig. 12.



Case XII. Fetid bronchitis mistaken for right lower lobe bronchiectasis.

Fig. 13.



Case XIII. Case of bronchiectatic infection of entire right lower lobe.

CONCLUSIONS BASED ON OBSERVATIONS IN THE CASES RECORDED.

1. The differential diagnosis of true lung abscess and suppurative bronchiectasis is important.

2. Radiographic study of each case is essential.

3. Bronchoscopic examination is a valuable procedure, and should not be omitted.

4. Drainage of a lung abscess by thoracotomy is likely to result in cure.

5. Drainage of large infected bronchiectases may be followed by improvement, but complete recovery is unlikely.

6. Extensive thoracoplasty should be reserved for those cases in which other operations have failed.

7. Exploration of the pleural cavity and of the lungs by intercostal thoracotomy is feasible and reasonably safe.

8. Extirpation of a bronchiectasis by removal of the affected portion of lung may lead to complete recovery. The danger of the operation is great.

9. Artificial pneumothorax and Tuffier's extrapleural tamponade should be reserved for cases of pure tuberculosis.

10. Intratracheal insufflation is a simple, accurate and safe method of securing differential pressure.

11. Operations involving one lung can be performed with inhalation anæsthesia.

VISCERAL PLEUРECTOMY FOR CHRONIC EMPYEMA.*

BY CHARLES H. MAYO, M.D.,

AND

E. H. BECKMAN, M.D.,

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CHRONIC empyema is a condition which is quite common in spite of the fact that it results, in most instances, from the failure of early diagnosis and the establishment of sufficient drainage in the acute stage. In the acute stage, if free drainage is established early and the adhesions broken up at the time of the first drainage, the lung re-expands quickly, thus obliterating the abscessed cavity, and the patient goes on to rapid recovery. In the neglected case in which the infected fluid remains in the pleural cavity for a considerable length of time, the pleura becomes so thick and fibrous that even after free drainage is established, the lung cannot re-expand. In nearly all cases, this is because of the adhesions and the thickened pleura, and not due to any extensive disease of the lung. It is true that in some cases there is an abscess in the lung which drains spontaneously into the pleural cavity, but this does not seem to be the usual way in which an empyema takes place.

In the chronic cases of empyema the ribs prevent the chest wall from dropping in and the adhesions and the thickness of the pleura prevent the lung from re-expanding. The result is a large cavity which continues to discharge varying amounts of pus. Nature cannot obliterate this cavity, as she ordinarily obliterates cavities by collapse of the tissues about it. Neither can she force granulations through the fibrous wall of the abscess.

Various methods have been devised by surgeons to obliterate this cavity. Estlander [1] resected the ribs subperiosteally over the entire area. The number of ribs resected varies with the size of the cavity. It is important to be radical and to resect one rib too many rather than one too few in order that no dead space remains in the upper or lower part of the cavity to continue suppuration. Many surgeons have modified this operation; for example, Saubouttin,[2] Beck,[3] Quenu,[4] and Tietze [5] resected small portions of the ribs through parallel and vertical incisions of the region involved. Jaboulay and Leymarie [6] divided the sternal attachment of the ribs, making use of the articulation at the vertebral column to mobilize the chest-wall, while Boiffin [7] recommends resection of the ribs close to the vertebral column, making use, as it were, of the mobility of the costal cartilages. More recently, Wilms [8] has combined these two operations and resects a couple of inches of several ribs along the spine and also along the sternum in order to mobilize the chest-wall. Schede [9] noticed that some empyema cavities did not heal even after extensive resections of ribs. He observed that the thickened pleuræ did not unite with each other but directly impeded recovery. Consequently, he devised the operation which bears his name. This consists of removing not only the ribs covering the empyema cavity, but also the thickened parietal pleura and the intercostal muscles, so that the skin and superficial muscles rest directly against the thickened visceral pleura. This operation is usually performed through a U-shaped incision beginning along the external margin of the pectoralis major muscle to the lower part of the thorax and then backward and upward to the median line of the scapula. The skin, superficial muscles and scapula are then reflected upward, while the pleura, ribs and deeper muscles are removed over the entire cavity. The operation is severe and the shock to the patient is often alarming if not fatal, especially since many of these patients are in an extremely debilitated condition.

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* Read before the American Surgical Association, April 10, 1914.

In 1893, Fowler,[10] operating on a woman thirty-five years of age who had had an empyema with a fistula for ten years, dissected out the scar tissue surrounding the fistulous tract and removed the entire mass of fibrous tissue from the diaphragm and lung. He was surprised to discover that the lung began to re-expand as soon as this thick scar tissue was peeled from it. The patient recovered from the operation and the wound entirely healed within a few weeks. The case was reported in December, 1893. In commenting on the case, Fowler stated that the history suggested a method of dealing with some of the cases of old empyema with a persistent sinus which resists all the means usually employed for their cure.

DeLorme,[11] after observing autopsy cases of old empyema, decided that the lung would re-expand if the thickened pleura was removed from it. Consequently he devised the same operation and reported it about three months later, in the early part of 1894. Unfortunately, his patient died from hemorrhage and shock.

These two men performed the same operation and arrived at the same conclusions concerning these cases, the difference being that one of them performed the operation, following out the steps as he proceeded, while the other studied out the operation in advance and then performed it. Ransohoff,[12] following the work of Fowler and DeLorme and appreciating the difficulty of removing the thickened pleura in some cases, advised making multiple incisions at right angles to each other about a quarter of an inch apart, through the thickened pleura down to the lung, so that the entire visceral pleura should be gridironed. This is a valuable procedure and may often be used with good results in conjunction with visceral pleurectomy.

We believe that the operations of Fowler and DeLorme have not received the attention from American surgeons which they deserve. We have been able to find but twenty-four cases reported in the literature by three operators in the twenty years that have elapsed since the reports of Fowler and DeLorme. The efforts of surgeons up to the time of their reports had evidently been directed entirely to obliterating the cavity in chronic empyema by collapsing the chest-wall. They apparently had not appreciated the fact that in most instances the lung itself was not badly diseased and that it would re-expand to a greater or less extent if given an opportunity. Even to-day the possibility of restoring a portion or even an entire lung to the patient is not fully appreciated. In this age of conservation it certainly seems worth while to attempt it even if we do not always succeed in restoring to the patient the use of a portion of such a valuable organ as the lung.

Keen's Surgery [13] states that, as a rule, satisfactory results cannot be expected by this method if the operation is undertaken after four or five months have elapsed since the primary drainage. Von Bergmann's Surgery [14] tells us to try decortication of the lung when other methods fail. If it is possible for the lung to re-expand in a reasonable proportion of the cases without involving more danger to the patient than by other methods, we accomplish everything that is accomplished by the other methods and, in addition, restore to the individual the use of a lung or portion of a lung. This factor certainly seems important enough to be considered seriously. In previous years the results from the Estlander and Schede operations were so discouraging that, through a process of evolution, we have gradually taken up the operation of visceral pleurectomy in conjunction with these other procedures.

We wish to report two cases in which this thickened pleura was removed from an entire lung in an adult, in both cases more than six months after a primary drainage.

Case I (No. A31028).—Male, aged twenty years. Date of operation November, 1911. Patient had had typhoid fever. Sick for three months following the typhoid when an empyema was discovered on the right side and drained. This was in January, 1908. This had been draining at intervals until he first came under observation. Examination revealed a nearly collapsed lung on the right side, with an enormous cavity which extended from the diaphragm to the clavicle. Through an opening large enough to explore the cavity, the thick, fibrous pleura over the entire lung was removed. There were a number of fibrous bands which entered into the tissue or the lung and others that bound it to the diaphragm. These were freed as well as possible. The case was considered very unfavorable after the operation was finished. To our surprise, the lung soon filled the entire thoracic cavity and drainage was entirely stopped by January 5, 1912, fifty-one days after the operation. There were good breath-sounds over the entire right thorax, the patient steadily gained in health and strength and has remained entirely well to the present time.

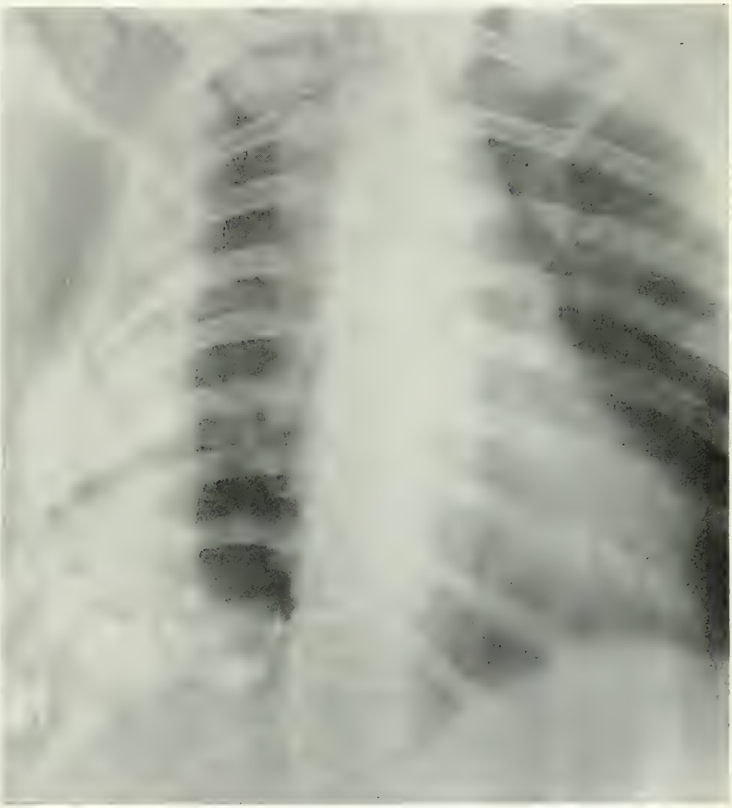
Case II (No. A77103).—Male, aged twenty-three years. Examined December 7, 1912. Was shot with a rifle through the left chest in October, 1912. Bullet entered from in front, passed entirely through the thorax and was found lodged under the skin of the back. Three weeks later an empyema was drained. When examined the left thorax was shrunken, the patient very weak and emaciated and the entire left lung collapsed. He was advised to return to his physician to get in better condition to undergo a pleurectomy.

Six months following the primary drainage, in May, 1913, he returned for operation. A complete visceral pleurectomy of the left lung was made. The thickened pleura was removed from the lung, diaphragm and pericardium as well as possible. There was very little bleeding and, although the patient was emaciated and weak, there was almost no shock following operation. Drainage ceased entirely in three months. There were good breath-sounds over the entire thorax and he had gained nineteen pounds in weight. Two months later the patient returned with a small collection of pus in the pleural cavity under the left axilla. This was drained. He still has a small cavity at this point which will require further operation but at least two-thirds of the lung is functionating.

These two cases illustrate the possibility of a collapsed lung re-expanding even after many months. We do not intend to say that such results can be accomplished in every case of chronic empyema, and we realize that pleurectomy must be combined with resections of rib and the Ransohoff technic in most instances. We wish to emphasize the fact that in our experience pleurectomy has not produced anywhere near the same degree of shock that the Schede operation does. We believe that in most instances it should be attempted before extensive resections of rib are undertaken. If the lung only partially expands, resections can be done at a second operation without any loss except the time of the patient.

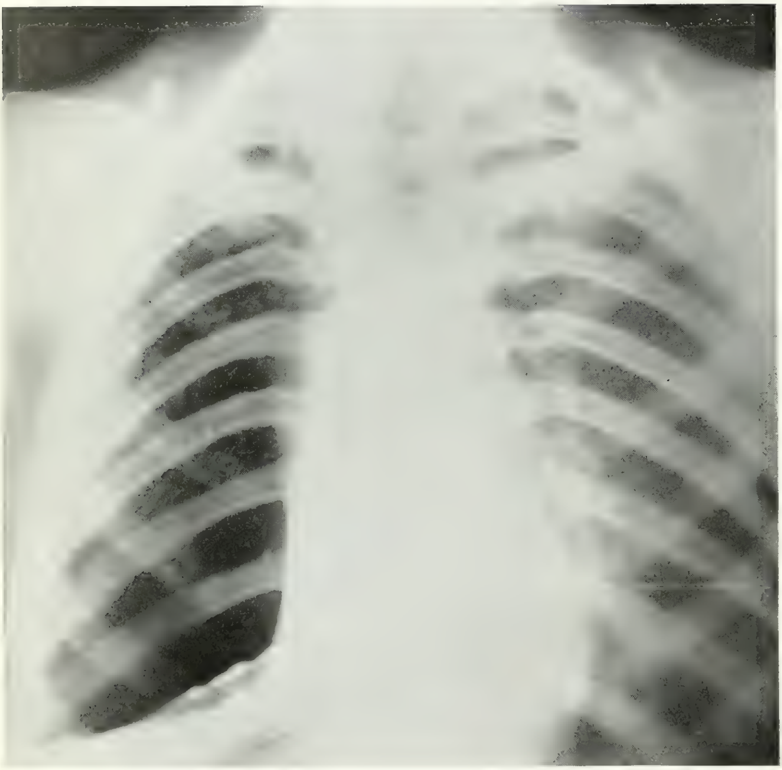
Tüffier[15] recommends that with the patient in poor condition the operation be divided into several stages, rather than

FIG. 1.



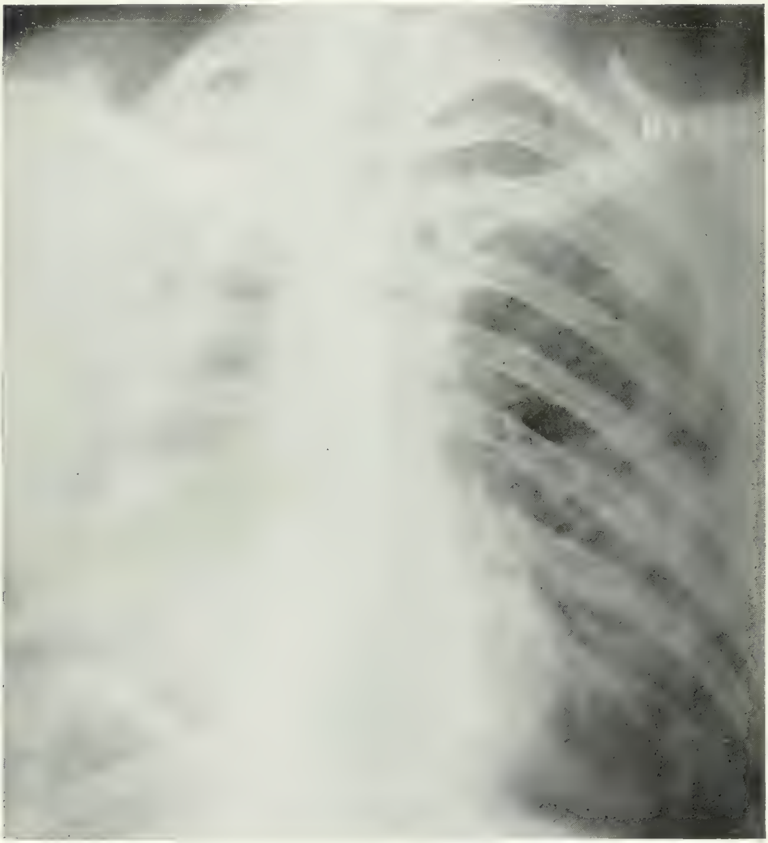
Before operation.

FIG. 2.



Before operation.

FIG. 2*a*.



Some weeks after operation, showing re-expansion of major part of the lung.

attempting to complete it in one stage. He also recommends the DeLorme operation in selected cases. We also believe that many of these cases should be operated upon in stages, and pleurectomy can be attempted. If this does not obliterate the entire cavity, one usually gains some lung expansion and the remainder of the cavity can be obliterated later by the Estlander or Schede operation.

We wish to report two other cases in which the wound healed primarily following pleurectomy.

CASE III (No. A71074).—Male, aged twenty-two years. Patient with a left sided empyema following pneumonia, which had drained at intervals for thirteen months. A cavity six inches in diameter posterior to the pericardium was explored and the thick membrane covering the pleura and diaphragm removed. The cavity healed entirely in thirty-nine days.

CASE IV (No. A73419).—Male, aged eighteen years. Patient had a left sided empyema which had drained for over two years. At operation, a cavity the size of a large grape-fruit was found external to the pericardium. The thick membrane was pealed from the lung and partly from the pericardium. The cavity closed in three weeks.

In discussing the treatment of such cases, a word should be said in regard to the preparation of the patients for operation. Many of these patients are as much in need of preoperative preparatory treatment as patients about to undergo an operation for prostatectomy.

It is very important that the drainage should be at the most dependent part of the cavity. We have seen several patients gain from fifteen to twenty-five pounds in a few weeks with a corresponding gain in strength by changing the point of drainage to the most dependent part of the cavity. Autogenous vaccines should also be employed. After the patient has stopped gaining, following such an operation for drainage, and is in the best condition possible, irrigation of the cavity twice daily with a weak iodine solution helps reduce the infection to a minimum. In regard to the operation itself, sufficient exposure must be obtained to make every portion of the cavity freely accessible. The entire cavity should be cleansed as thoroughly as possible and then swabbed with strong tincture of iodine before pleurectomy is begun. The incision through the thickened pleura is best started posteriorly along the vertebræ, as there is less danger, especially on the left side, of entering the pericardium. One need not fear slitting entirely through the thick pleura down to the healthy lung, as the bleeding does not seem to be excessive, and, although the lung has been injured enough to allow air bubbles to escape, in almost every instance no harm has arisen from such injury and apparently no extensive infection to the lung by such exposure has occurred. Pneumonia has not occurred in any of the seven cases in which pleurectomy has been performed. Abundant drainage to the furthest points of the cavity should be provided for by small gutta-percha drains to prevent reaccumulation of the fluid in the pleura. One operative death has occurred in this series. With our present knowledge we believe that too extensive an operation was attempted on this case. Now we divide the operation into stages when necessary.

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[2] Saubouttin: Chir. du thor., Schwartz, 1912, p. 248.

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[4] Quenu: Chir. du thor., Schwartz, 1912, p. 248.

[5] Tietze: Quoted by Beck. "Surgical Diseases of the Chest," 1907.

[6] Jaboulay and Leymarie: Lyon méd., 1909, t. cxiii, p. 1075.

[7] Boiffin: in Th. Gourdet, Paris, 1895.

[8] Wilms: Personal communication.

[9] Schede: Keen's Surgery, vol. iii, p. 553.

[10] Fowler: Med. Rec., December 30, 1893, pp. 838–839.

[11] DeLorme: Seventh Congres de Chir., 1893, Paris.

[12] Ransohoff: ANNALS OF SURGERY, xliii, 1906, pp. 502–511.

[13] Keen's Surgery.

[14] von Bergmann's Surgery.

[15] Tüffier: Etat Actuel de la Chirurgie Intrathoracique, 1914.

THE PLEURAL AND PULMONARY COMPLICATIONS OF TROPICAL ABSCESS OF THE LIVER.

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A DESCRIPTION of the anatomic relations of the liver to the diaphragm and to the structures in contact with the upper surface of the diaphragm will make the study of the paths of direct extension of infection much easier to understand.

Most of the upper or convex surface of the liver is in contact with the diaphragm. Over the greater part of this area of contact the peritoneal cavity intervenes, potentially at least, each opposing structure being covered by its own layer of peritoneum. Over the rest of the area the liver and diaphragm are in actual structural contact, being separated by a layer of connective tissue only. *The area uncovered by peritoneum* is bounded in front by the attachments of the anterior layer of the right and left coronary ligaments and by their junction with the falciform ligament; behind by the posterior layer of the right and left coronary ligaments, and their reflection on to the posterior borders of the lobes of the liver and the anterior surface of the vena cava. Figure 1 representing the upper surface of a liver shows this area darkly shaded. The vena cava inferior grooves the liver at the middle of its posterior edge. It will be seen that at least four-fifths of this area lies in the right lobe of the liver. If a number of livers are examined in the dissecting room, it will be found in most cases that the highest point of the convex surface of the right lobe occupies a portion of the organ in front of this area, but that occasionally a liver is met with where the uncovered area represents the highest point and occupies the dome of the diaphragm. A study of the under surface of the diaphragm shows a replica of the upper surface of the liver.

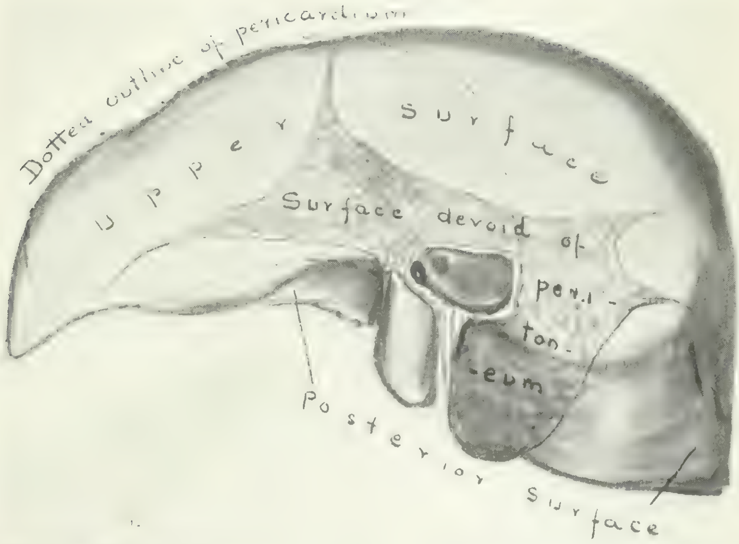
It has been stated by some writers that most liver abscesses that penetrate the diaphragm pierce it through this uncovered area. There is no doubt that it is a fairly frequent path of direct infection, but I have failed to find enough evidence to support the statement. It seems to be an easy matter for an abscess in any part of the liver to contract adhesions to the under surface of the diaphragm and to pass upward through it. The frequency with which abscesses tend to point through the lower intercostal spaces in the axillary line, suggests at least that the peritoneum is no barrier. If an abscess occupies the upper portion of the right lobe of the liver, as it increases in size it will bulge toward the pleural cavity and the first effect will be to push the diaphragm against the chest wall, and obliterate the lower portion of the phrenicocostal sinus (Fig. 2). By doing so the lower edge of the lung is pushed upward, and is prevented from reaching the lower limit of this space even in forced inspiration. If the abscess extends in this direction, adhesion of the two layers of peritoneum and pleura occurs in advance and both peritoneal and pleural cavities are obliterated at these points. If, however, the abscess extends upward it may open into the pleural cavity above these adhesions, or directly into the lung if adhesions have formed between it and the upper surface of the diaphragm. The structures lying on the upper surface of the diaphragm, that correspond to the upper surface of the liver, are the whole base of the right lung, the base of the pericardium, and part of the base of the left lung. Fig. 1 explains this clearly. The area outlined in red represents the area of liver which is in relationship with the pericardium above. It is seen to occupy almost the whole of the upper surface of the left lobe and a considerable part of that of the right lobe, including almost half of the area uncovered by peritoneum. A very small area of the upper surface of the left lobe touches that part of the diaphragm in contact with the left lung. The right lobe of the liver touches the diaphragm over the whole area corresponding to the under surface of the right lung. Fig. 2 is a right lateral, sagittal section, and shows the reflection of peritoneum in front and behind, from the upper surface of the liver on to the diaphragm and posterior body wall. The phrenicocostal sinus is shown in front and behind.

Secondary extension of the inflammation from the liver to the lungs may occur in one of two ways.

1. By direct extension through the diaphragm.

2. By embolism of the pulmonary arteries due to the abscess bursting into the hepatic veins or into the vena cava.

Fig. 1.



Upper and posterior surfaces of liver. Shaded area uncovered by peritoneum. Dotted line outline of pericardium. Most of this pericardial area is occupied by central tendon.

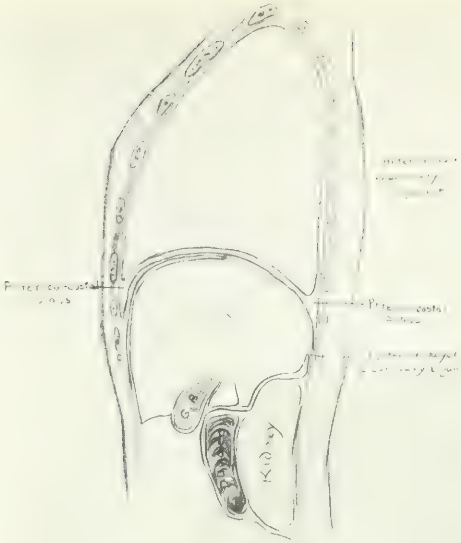
I. DIRECT EXTENSION THROUGH THE DIAPHRAGM.

From the preceding anatomical description the paths of direct extension into the pleural cavity and to the lungs will be easily understood. The pleural cavity is probably never invaded by metastasis but always by direct extension, and the same path usually holds good for the lower lobes of the lungs. The process with a few modifications is as follows: Extension of the original liver abscess proceeds toward the diaphragmatic surface of the liver. The diaphragm is incorporated into the abscess cavity and is gradually destroyed. What occurs next will depend on a number of factors. If the necrotic process is rapid and no antecedent pleurisy has caused adhesion of the lower lobe of the lung to the diaphragm or to the chest wall, the pleural cavity will be opened and the contents of the abscess emptied into it suddenly, producing serious fulminating symptoms of dyspnœa and all the signs of an acute pleural effusion (Thomson). Usually the diaphragm is penetrated slowly and actual perforation is preceded by pleurisy, just as peritonitis precedes perforation of the abdominal viscera. The inflammation of the pleura may terminate in an accumulation of fluid, or in adhesions between the lung and the diaphragm or chest wall, or in both conditions to a different degree. In quite a large number of cases effusion is present in greater or lesser quantity. At first it is serous and sterile; later, it may become infected and seropurulent or purulent. At first the accumulation occupies the lower region of the chest cavity, the diaphragm forming its lower boundary. If no adhesions form between the lung and the chest wall the whole pleural cavity may become involved and filled with fluid. Owing to the frequency of adhesions between lung and parietal pleura, localized collections in the lower portion of the pleural cavity or even between the lung and diaphragm are more common.

When the diaphragm is perforated finally, the pus from the liver abscess mixes with the pleural fluid, imparting to it its own peculiar physical characteristics. The mingling of the two fluids is rarely attended by acute symptoms, because the pleural surfaces are now less susceptible to injury and the absorption of morbid products is less active. At the most, there may be slight increase in pain or dyspnœa. The change of the fluid from serous to purulent may be discovered by chance even, at a subsequent tapping. When adhesions form between the diaphragm and the under surface of the lower lobe of the lung, the pleural cavity is shut off at an early date. As a rule, the application of the two surfaces is close and no cavity is left. But occasionally a small portion of the pleural cavity is imprisoned between the lower surface of the lung and the upper surface of the diaphragm. In the former case the inflammatory process passes slowly through the diaphragm into the lungs and the abscess cavity bores its way through the lung tissue until a bronchus is opened, into which the contents are finally discharged. In the latter the abscess opens first into the intervening cavity and later bores its way through the lungs.

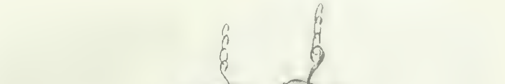
The post-mortem appearances of such conditions show marked anatomic variations. In some instances (usually recent cases) the hepatic abscess may still be of a reasonable size and the pulmonary track short and comparatively narrow. At a later date the track through the lung may be transformed into a large cavity which communicates with a similar cavity in the liver (Fig. 4). (Strong.) In others (older cases) the hepatic abscess may be reduced to a very small size, while the track in the lung may show extensive cavitation, of irregular shape and with ragged disintegrated walls. This disproportion between the cavities in the lung and liver is often so marked that the liver abscess may be considered as practically healed (Fig. 3). The cause of death in such cases must not be ascribed to the destruction of liver tissue, but to the pleural or pulmonary complications; or, in rare instances, to metastatic infection of other organs. In one of our cases (Case X) an abscess had opened primarily into the lower part of the pleural cavity, the lung being penetrated secondarily. The post-mortem examination showed that the liver abscess had almost healed up and that nearly all the pus which was being discharged through the bronchi had been formed in the pleural cavity and in a cavity found in the lungs. The lower lobe of the right lung

FIG. 2.



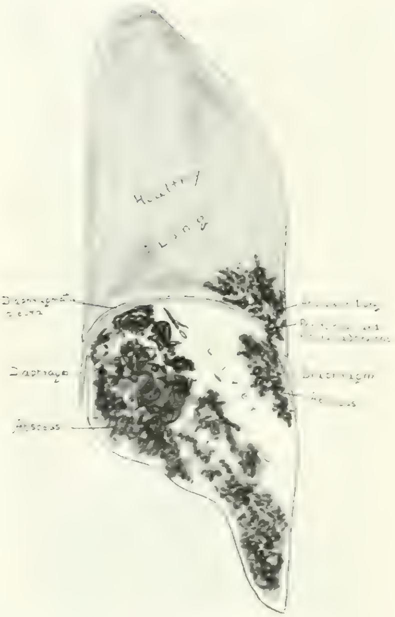
Right lateral sagittal section, 3 inches from medial plane.

FIG. 3.



Specimen of liver and lung laid open, showing abscess in liver almost healed but abscess in lung very large and active. (Path. Museum University of Texas.)

FIG. 4.



Sagittal section of lung and liver, showing multiple abscesses in the liver and a small abscess in the lung communicating with one in the liver. (Path. Museum University of Texas.)

was occupied by a cavity as large as a man's fist, the walls of which were disintegrated and friable. The contents consisted of pus of a chocolate color. The cavity drained externally into a large bronchus and opened by a small aperture into the pleural cavity. There was no direct connection between it and the liver. Careful examination of the upper surface of the diaphragm revealed a shallow excavation in its upper surface not more than one-half an inch deep and three-fourths of an inch wide. The walls of this cavity were formed by cicatrized liver tissue. Section of the neighboring liver showed an insignificant amount of cicatricial tissue. A profuse amount of pus typical of liver disintegration had been discharged daily for months in the expectoration and by drainage from the thoracic cavity. Death finally resulted not from liver or lung infection, but from infection (abscess) of the brain. In another case (Case XI) recently observed, giving a typical history of hepatic abscess with pleural and pulmonary involvement associated with expectoration of large quantities of chocolate pus, the lower portion of the pleural cavity and the upper surface of the diaphragm were fully exposed to view by an extensive excision of the chest wall. No trace could be found of a liver abscess, although a most minute search was made. The pleural cavity contained a large quantity of thick, white pus mixed with masses of chocolate colored pus. We were also unable to find the opening from the pleural cavity into the lung. As this case recovered it is within the bounds of possibility that our observations may be incorrect. A similar case is quoted by Marion.

We have strong evidence pointing to transference of the amœbic infection from the liver to the lungs, for Lafleur and others have shown that the walls of the pulmonary cavities contain amœbæ, and they ascribe the extensive destruction of the lung to the agency of these organisms. It is impossible to explain the persistence of the symptoms and the extension of the ulceration by any other hypothesis. I have been able to collect some cases that seem to me to admit of no other interpretation. Such are the cases reported by Roch, Suzuki, Cantlie, Godlee and others, in which the presence of a liver abscess was clearly demonstrated as the primary infection either at autopsy or during life. In each one of these cases the liver abscess had healed up and the cause of death was abscess of the lung. Marion and Natton-Larrier have reported cases of amœbic abscesses of the lungs in which the symptoms pointed strongly to hepatic abscess as a primary condition, but in which no liver abscess could be demonstrated at the time of operation. Appended here are short résumés of the cases mentioned above:

I. INFECTION OF THE LUNGS BY DIRECT INVASION.

Roch reported a case in which the liver abscess penetrated the diaphragm and chocolate pus was expectorated. Death finally occurred from exhaustion. At the autopsy there was only a cicatrix to show the site of the liver abscess. The entire base of the right lung was occupied by purulent cavities.

Suzuki mentioned a case of successful operation for hepatic abscess following dysentery. Eight months later an abscess formed in the upper lobe of the right lung, which was opened successfully.

Cantlie reported a case of successful operation on a liver abscess. Six months later empyema of the right pleural cavity developed. After draining, the patient died. Autopsy showed an abscess in the upper lobe of the right lung. The liver abscess had healed completely.

Godlee: Three such cases are reported by Godlee.

(1) Case 8.—A patient spitting up chocolate-colored pus was operated upon and an abscess in the base of the right lung opened. The finger was passed through the diaphragm into an abscess cavity in the liver. Two months afterward the patient died from hæmoptysis. The autopsy showed irregular cavities in the right lung, but that in the liver had healed up.

(2) Case 9.—A patient with abscess of the liver began to spit up chocolate-colored pus. Eventually, an abscess in the base of the right lung was opened on two occasions. Death occurred from abscess in the brain. The autopsy showed little or nothing to indicate the old abscess of the liver.

(3) Case 10.—A patient with abscess of the liver developed signs of an abscess at the base of the right lung. This was opened and drained. He eventually died from an abscess in his brain. The autopsy showed an extensive abscess in the lung, but nothing except adhesions between the liver and diaphragm to indicate the old abscess in the liver.

Marion reported a case of abscess of the lung, with profuse expectoration of pus containing no other organisms except amœbæ. The patient had suffered from several attacks of amœbic dysentery. Abscess of the liver was suspected but not found either by aspiration or at operation. Resection of ribs revealed adhesion of lung to diaphragm, but no abscess in the liver (compare our cases). An amœbic abscess the size of an orange was found in the lower lobe of the right lung. The patient recovered.

Natton-Larrier reported a case of a patient with a history of dysentery, who developed an amœbic abscess in the lower lobe of the right lung. During operation for draining the liver abscess, no affection of the liver was discovered. The patient recovered.

2. INFECTION OF THE LUNGS BY EMBOLISM.

Compared with direct invasion, infection by this route is very infrequent. Many reported cases are open to serious doubt because of the carelessly conducted autopsies. Others must be accepted unequivocally.

The one reported by Colin is typical of this condition. A patient with abscess of the liver died with symptoms of intense dyspnœa and asphyxia. The autopsy showed an abscess of the liver which had opened into the ascending vena cava. Scattered abscesses were found in both lungs.

Laferrére reports a case of abscess in the left lobe of the lung consecutive to one in the right lobe of the liver.

Bunting mentioned a case of amœbic abscess of the liver with no involvement of the diaphragm or pleura, in which an abscess cavity was present in the upper lobe of the right lung. There were absolutely no signs of direct extension of communication between the two abscesses.

On reflection it is rather remarkable that this mode of infection should be so rarely encountered. Perhaps the low intensity of the inflammation, the extent of fatty degeneration in the liver tissue surrounding the abscess cavity, and the frequent absence of microörganisms other than amœbæ explain the rarity of embolism; or, on the other hand, it is probable that the lungs are particularly resistant to the invasion of amœbæ under ordinary conditions. That under certain conditions amœbæ do pass from the abscesses into the hepatic veins and into the lungs and even through their capillaries into the systemic circulation is shown by the appearance of cerebral abscesses of embolic origin, containing amœbæ. One of our cases (Case X) at autopsy showed an abscess in each frontal lobe and in the left lateral cerebellar lobe. Many such cases have been reported.

Protherat reported a case of amœbic liver abscess, with purulent expectoration also containing amœbæ. The patient died with marked cerebral symptoms and the autopsy showed a brain abscess containing amœbæ. Kartulis has stated that brain abscesses occur in 3 per cent. of all liver abscesses.

SYMPTOMS OF PULMONARY AND PLEURAL INVOLVEMENT.

Added to the symptoms of hepatic abscess, the first sign of importance is severe pain in the shoulder. This is always a symptom of diaphragmatic involvement. It may be accompanied by increase in pain and tenderness over the lower part of the chest, which is suggestive of involvement of the lower portion of the pleural cavity. A distressing tickling or hacking cough may be present at this time, with or without any signs of pleural effusion. The symptoms increase in intensity until, without any other warning, the patient may expectorate suddenly a large quantity of chocolate-colored pus. Temporary relief of the symptoms follows and the patient may improve daily in health, if the drainage is free and if too much liver tissue has not been destroyed. When the drainage is free, pus flows without hindrance into the bronchi and is expectorated constantly. As time passes the quantity expectorated diminishes, and in some (rare) cases the abscess cavity may heal up completely and a spontaneous cure may result. In other cases drainage may be intermittent. Periods of profuse flow alternate with those of scanty flow or it may even cease for a time. During the periods of profuse flow the patient is free from pain and fever. When the flow ceases, pain and fever return again. In cases that drain poorly the outlook is serious, because the conditions favoring progressive necrosis of liver tissue are still present; and, further, the continued use of the lung as a channel for the discharge allows the amœbic infection to gain a stronghold in lung tissue and to cause extensive destruction and cavitation.

The foregoing description applies to that class of cases where adhesions between the lung and diaphragm have preceded the pointing of the abscess. Where no adhesions have formed the abscess opens directly into the pleural cavity and fills it more or less. Signs of serous effusion often antedate actual perforation, in which event, except for an increase in the quantity of fluid, the physical signs do not alter. In such cases it is often impossible to determine the time of actual perforation, symptoms of empyema being gradually added to those of serous effusion. The change in the character of the fluid is often discovered by chance after aspiration. In the event of perforation of the abscess into an intact pleural cavity (probably very rare) very acute symptoms come suddenly. Pain and dyspnœa are intense. The whole pleural cavity may fill up in a very short time and the lung may be acutely compressed. If these cases are left to Nature and the pleural cavity is not drained, the outlook is very grave. Spontaneous evacuation of the accumulation may occur through the lung or through the chest wall. The former route is probably the most frequent. Even in cases that are drained, the mortality is very high. Pus is often discharged through the chest wall and into the bronchi simultaneously and in many instances drainage of the pleural cavity fails to relieve the expectoration completely. Some cases recover, but many of them die from exhaustion. Occasionally, cavities form along the drainage track in the lung in spite of external drainage, and from them pus of a chocolate color is expectorated constantly.

FREQUENCY OF PLEURAL AND PULMONARY INVOLVEMENT.

This has been estimated variously by different writers.

Rendu, analyzing 563 cases, found 31 cases where the abscess had opened into the pleural cavity, or 5.5 per cent. Molinié stated that it occurred in 8.9 per cent. of cases; 5.5 per cent. for the opening of the abscess into the pleural cavity and 3.4 per cent. for the presence of serous effusion. Harris found the pleural cavity involved 3 times in 95 cases. Futcher, in 119 cases, found the lung involved in 6 and the pleural cavity in 3 cases. Strong, in 100 fatal cases, found the lung involved in 1 case and the pleural cavity in 2 cases.

Our cases show a marked contrast. In 27 cases we found the lung and pleural cavity affected in 11, *i.e.,* 40.8 per cent.

PROGNOSIS.—This can be more conveniently discussed under two heads:

1. The prospects of spontaneous cure.

2. The results of operative procedures.

1. *Spontaneous Cure.*—This result may be hoped for in a small proportion of cases in which the abscess penetrates the lungs directly without infecting the pleural cavity, but it probably never occurs when the pleural cavity forms an intermediary channel between the liver and the bronchus. Quite a number of cases have been reported from time to time that can be accepted without cavil as instances of real cures. Such are two reported by Vertiz, where a period of good health had elapsed, without bad symptoms, long enough to justify the conclusion that the abscesses in both liver and lung had healed. Others cannot be accepted without question. Such are two reported by Phillips, which were treated with ipecac and emetin, but were under observation too short a time to justify the conclusion that they were cured. It has been my privilege to see five cases where the abscess opened directly through the lungs. Of these only one certainly recovered (Case VII), not spontaneously, but following excision of the chest wall, and drainage of the abscess cavity. Another (Case VI) left hospital in 30 days, still expectorating chocolate-colored pus and having a septic temperature. A third (Case V) died in hospital four months after admission from exhaustion, spitting chocolate-colored pus to the last. The two others are not in the case reports, having been under observation prior to the year 1907. Both died eventually from exhaustion, with every symptom of pulmonary abscess, spitting chocolate-colored pus to the last. In only one, *i.e.,* the case that recovered, was the abscess located by aspiration. We failed signally to find the abscess cavities by the aspirating needle in all the rest.

2. *The Results of Operative Procedures.*—The mortality of hepatic abscess in general is always high. Varonoff collected 1089 cases which were operated on in Egypt, during a period of 25 years, and found a mortality of 34 per cent. in those operated on by a large incision, and a mortality of 60 per cent. in those treated with the trochar and cannula. Martin, in Cambodge, found a mortality of 37.5 per cent. Gaide, in Toulon, found a mortality of 33 per cent. The best statistics

on a series of consecutive cases is given by Cantlie. Out of 100 cases there were 82 recoveries and 18 deaths, a mortality of only 18 per cent. Of these cases 90 were treated by evacuation with a trochar and cannula (Manson's method). Our own mortality for the cases reported was, roughly, 29 per cent.

A separate analysis of the cases showing pleural and pulmonary complications reveals an enormous increase in the mortality. According to Molinié the mortality is as high as 84.8 per cent. Our own mortality for a consecutive series of cases amounts only to 45.4 per cent., but the number is small. It is my conviction that a mortality of 75 per cent. would represent an average. If every case leaving hospital could be followed up many of those discharged as improved would be found to have died of exhaustion. An analysis of our own reports will explain this statement.

I have made an analysis of our own reports since 1907, and find that 27 cases of hepatic abscess have been operated upon. The results which I have tabulated very carefully are as follows:

Cured	13,	roughly, ... 48 per cent.
Improved	6,	roughly, ... 22 per cent.
Died	8,	roughly, a mortality of 29 per cent.

Condition of the 13 Cured Cases when Discharged.

No. 1 was discharged in 30 days with normal temperature.
No. 2 was discharged in 21 days with normal temperature.
No. 3 was discharged in 40 days with normal temperature.
No. 4 was discharged in 3 months with normal temperature.
No. 5 was discharged in 2 months with normal temperature.
No. 6 was discharged in 49 days with normal temperature. (Case VII).
No. 7 was discharged in 3 months with normal temperature. (Case IX).
No. 8 was discharged in 44 days with normal temperature. (Case II).
No. 9 was discharged in 20 days with normal temperature.
No. 10 was discharged in 22 days with normal temperature.
No. 11 was discharged in 31 days with normal temperature.
No. 12 was discharged in 3 months with normal temperature.
No. 13 was discharged in 30 days with normal temperature.

None of these cases left hospital with any fever. Some had a slight discharge that required a dressing, but the condition of all of them was practically well. Of them three (Nos. 6, 7 and 8) were complicated with pus in the pleural cavity.

Condition of the 6 Cases Marked Improved when Discharged.

No. 1 was discharged in 26 days. Temperature slightly elevated.

No. 2 was discharged in 24 days. Temperature septic, 99° to 102°.

No. 3 was discharged in 60 days. Temperature septic, 90° to 102°.

No. 4 was discharged in 30 days. Temperature septic, 99° to 102°. Spitting pus (Case VI).

No. 5 was discharged in 3 months. Temperature septic, 99° to 102°. Spitting pus (Case IV).

No. 6 was discharged in 36 days. Pleural cavity wide open and lung collapsed. Spitting up pus (Case XI).

It is evident that the condition of these patients was anything but satisfactory and some of them eventually died of exhaustion. There were *three* of these suffering from pleural and pulmonary complications (Nos. 4, 5 and 6).

Deaths.

time of death and cause of the 8 deaths.

No. 1 died at the end of 4 months. Uncomplicated abscess. Died of exhaustion.

No. 2 died at the end of 48 days. Perforated the diaphragm. Opened into pleura and lungs. Very septic (Case VIII).

No. 3 died at the end of 4 months. Perforated diaphragm and opened into the lungs. Exhaustion (Case VI).

No. 4 died at the end of 28 days. Infected pleural cavity. Exhaustion (Case III).

No. 5 died at the end of 66 days. Opened into pleural cavity, and lungs. Very septic (Case I).

No. 6 died at the end of 16 days. Uncomplicated abscess. Death from peritonitis, following perforation of ulcer of cæcum.

No. 7 died at the end of 40 days. Pleural cavity and lung infected. Death from cerebral abscess (Case X).

No. 8 died at the end of 18 days. Uncomplicated abscess of left lobe of liver. Exhaustion.

It will be seen that five of the eight deaths (*vid.* Nos. 2, 3, 4, 5 and 7) occurred in cases where either the pleural cavity or lungs or both were affected, *i.e.*, 62.8 per cent. of the deaths occurred in this class of cases.

Out of the 27 cases, there were 11 with *pleural and pulmonary complications, i.e.,* 40.8 per cent.; of these 5 died, *i.e.,* a mortality of 45.4 per cent.

The following is a brief abstract of these cases:

CASE I.—Male; white; aged forty-nine. Abscess of right lobe of liver which had perforated diaphragm. Pleural cavity full of pus. Also coughed up quantities of pus. No amœbæ found. Drained with Manson's trochar; afterwards excision of ribs. No abscess found in liver. Continued to spit up quantities of chocolate-colored pus even after drainage. Died of exhaustion at the end of 66 days (*vid.* No. 5, deaths).

CASE II.—Male; aged twenty-nine. Abscess of right lobe of liver. Lower part of pleural cavity full of chocolate-colored pus. Amœbæ absent. Pleural cavity drained with trochar and cannula. Recovered (*vid.* No. 8, cures).

CASE III.—Female; colored; aged forty. Abscess of right lobe of liver. Right pleural cavity full of pus; chest wall œdematous from fifth interspace down. Breathing labored. No spitting of pus. Pleural cavity drained with trochar and cannula. No amœbæ found. Drainage free. Death from exhaustion in 28 days (*vid.* No. 4, deaths).

CASE IV.—Male; negro; aged twenty-seven. Abscess of right lobe of liver. Ruptured into the pleural cavity and lung. Spitting up of chocolate-colored pus. Amœbæ present at first in sputum and in pus aspirated from pleural cavity, but disappeared during convalescence. Pleural cavity drained. Discharged from hospital in 3 months with septic temperature and wound in chest still draining (*vid.* No. 5, improved).

CASE V.—Male; white, aged fifty. Abscess of right lobe of liver, which had perforated into the right lung. Expectoration of chocolate-colored pus. Pleural cavity intact. Aspiration of liver failed to reach abscess cavity. Expectorated constantly. Died at end of 4 months from exhaustion. No autopsy (*vid.* No. 3, deaths).

CASE VI.—Male; white, aged twenty-eight. Abscess of right lobe of liver. Perforation into the lung. Pleural cavity intact. Expectoration of chocolate-colored pus containing amœbæ. An attempt was made to reach the pus with an aspirator, but it failed. Discharged from hospital in 30 days with septic temperature (*vid.* No. 4, improved).

CASE VII.—Male; white; aged forty-nine years. Abscess of right lobe of liver. Spitting up of chocolate-colored sputum, containing amœbæ. Pleural cavity intact. Excision of seventh and eighth ribs. Diaphragm stitched to chest wall. Opened and drained abscess in upper part of liver. Cured in 49 days (*vid.* No. 6, cured).

CASE VIII.—Male; white; aged sixty-one years. Abscess of right lobe of liver. Perforation into the pleural cavity. Rupture into the lung and profuse expectoration of chocolate-colored pus. No amœbæ found. Pleural cavity drained. Death in 48 days from exhaustion. No autopsy (*vid.* No. 2, deaths).

CASE IX.—Male; negro; aged thirty-five years. Abscess in right lobe of liver. Perforation into the right pleural cavity. Chocolate-colored pus aspirated from both situations. No amœbæ found. Amœbæ present in the fæces. Pleural cavity drained after excision of part of the seventh and eighth ribs. Liver abscess drained through same opening. Recovery in three months (*vid.* No. 7, cured).

CASE X.—Male; white; aged forty-six. Abscess in right lobe of liver. Perforation into right lung and pleural cavity. Spitting up of large quantities of chocolate-colored pus. Amœbæ present in the pus. Amœbæ also present in the stools. Pleural cavity full of pus. Drainage of pleural cavity by trochar and cannula, followed by great improvement in general symptoms. Subsequent excision of a large part of the bony wall of the right thorax. Lung collapsed. No abscess could be found in liver. Death in 40 days. Liver abscess was practically healed. The lower lobe of right lung contained a large abscess cavity. Lung was collapsed (*vid.* No. 7, deaths).

CASE XI.—Male; white; aged sixty-two. Abscess of right lobe of liver. Perforation into right pleural cavity and lung. Expectoration of large quantities of chocolate-colored pus. Pleural cavity had been drained six months previously. Aspiration of cavity revealed chocolate-colored pus. Drainage with trochar and cannula. Slight improvement. Subsequent removal of a large part of the bony wall of thorax. No abscess was discovered in the liver. Lung was collapsed, but opening into it from pleural cavity could not be found; although fluid ran freely from pleural cavity into the air passages. Discharged from hospital in 36 days, with pleural cavity wide open and lung collapsed; also, with expectoration of chocolate-colored pus (*vid.* No. 6, improved).

Treatment.—Early diagnosis and prompt evacuation of the original abscess cavity is not only attended by a very low mortality, but is an effectual means of preventing these complications. A very large proportion of abscesses in the right lobe of the liver are capable of diagnosis long before they have penetrated the diaphragm, and they can be opened and drained with a trochar and cannula with every prospect of success. The cases that are difficult to diagnose and to reach with an aspirator are abscesses situated in the posterior and upper part of the right lobe near its junction with the left lobe. Some of them cause no local symptoms, except diffuse pain over the liver, until the diaphragm is involved, when pain in the right or left shoulder may be complained of. It is in such cases that sudden perforation into the lung and profuse expectoration of pus occurs so frequently. This accident sometimes happens without the patient knowing that he is suffering from liver abscess. Aspiration often fails to reveal pus in this portion of the liver, because sufficient care is not taken to search for it in the right direction and to a proper depth. Cantlie has given careful attention to the proper method of aspirating the liver and has formulated the following rules from measurements made on the cadaver. In a patient the circumference of whose body is 32 inches over the middle of the hepatic area, the vena cava inferior lies at a depth of 4½ to 5 inches from the surface of the body, along a line drawn backward horizontally (in the upright posture) from the xiphisternal articulation in front to the angle of the ribs behind. He also found that the vena cava is equidistant from any point in the usual operative area. Aspiration should be made systematically in a horizontal direction, penetrating the liver from right to left, each successive puncture being posterior to the previous one. By this means, a larger area of liver surface is explored than can be done with punctures in different directions. Even after most painstaking and repeated aspirations, failures are very common and the abscess may eventually penetrate the diaphragm. The course to pursue after the abscess has penetrated the diaphragm depends on the pathological condition of the structures involved. *If the pleural cavity is not infected, i.e.,* if the lung has adhered to the diaphragm before perforation and the abscess has opened into a bronchus through lung tissue, it is better to wait awhile to see what will happen. Some few cases recover spontaneously. The liver abscess collapses and cicatrization follows, both in liver and lung. This result is only reached after a tedious convalescence and is probably a rare termination. What usually occurs is that the abscess fills up and empties itself intermittently, because for some reason the track through the lung becomes blocked or obstructed from time to time. A persistence of this condition is likely to terminate in infection of the walls of the pulmonary track with amœbæ, which in turn will result in destruction and cavitation. Two cavities will then be present, one in the liver and the other in the lung, communicating with one another. Finally, that in the liver may heal up completely, but the cavitation persisting in the lung may extend and prove fatal. An accurate estimate of the true anatomical condition of the infected cavities is rarely possible. It is, however, necessary to bear in mind always that, at the time the case comes under observation, there may be no longer any abscess cavity in the liver. It is easy to understand why so many failures to reach the abscess cavity have been recorded. Even in cases where the abscess cavity in the liver still exists, it is practically hopeless to reach it while expectoration is free and profuse, because the walls are collapsed and the cavity is very small. The only time when aspiration is justifiable is when the expectoration ceases and the patient is febrile (*i.e.*, when the abscess cavity is full). Even under these circumstances successful aspirations are rare. Still, it is probably the best course to pursue and repeated attempts should be made before abandoning this method as not feasible. If aspiration fails an attempt may be made to reach the collection (1) by the abdominal or (2) by the transthoracic route. The abdominal route is hardly advisable in abscesses penetrating the right lung, because it is impossible to get within a reasonable distance of the point of perforation. Cantlie advises it strongly in abscesses of the left lobe. Through an incision in the left rectus the hand is thrust into the abdomen and the area of adhesion between the liver and diaphragm palpated. An aspirating needle is now thrust through the lower intercostal spaces in the direction of the abscess, being guided in its direction by the fingers in the abdominal cavity. The transthoracic route has been condemned because it may endanger the integrity of the pleural cavity. If conducted carefully by the method of Lannelongue, the cartilages of the seventh, eighth and ninth ribs can be removed and a large area of the upper surface of the liver uncovered by diaphragm can be rendered accessible. McLeod insists that a transthoracic operation is the only logical route, and bases his argument on the contention that the pathological focus in most cases is in the lung and not in the liver, because in this stage the liver abscess has healed up. It appears to the writer that this contention is well sustained by many post-mortem examinations, and that well conducted transpleural operations offer the best prospect of ultimate cure. The cases reported by Godlee support this position strongly.

If the pleural cavity is infected the problem becomes less complicated. It should be opened at once and a drain inserted. If necessary a segment of one or more ribs should be excised. If the condition of the patient allows it, the upper surface of the diaphragm should be examined and, if possible, the opening into the liver abscess found, enlarged if necessary and the cavity drained. Prompt attention will often save the lives of some of these patients. Collapse of the lung is often present and in old standing cases it is very unlikely that a great deal of expansion will follow even after decortication operations. A large number of these patients die sooner or later from exhaustion. In some instances the pleural cavity may contain pus which is being discharged into the lung and coughed up. As described above, the pleural cavity may be a reservoir and the lung tissue serve as a track or sinus along which the pus passes. On the other hand, the pus may pass from the pleural cavity into a lung cavity and thence into a bronchus. As previously stated, the liver abscess may be present or may have healed up. Such cases are almost hopeless. Even where no lung abscess is present the prospects of permanent cure are very slight. In the presence of a lung abscess, cure is very improbable. Still, we should do all we can. The lung abscess should be opened and drained; likewise, the liver abscess if it exists.

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THE CAUSAL RELATION OF TRAUMATISM TO TUBERCULOSIS.*

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THE Courts of Philadelphia and, I doubt not, the Courts elsewhere, are at times obliged to consider the question of the relation of trauma to tuberculous lesions—pulmonary, glandular, osseous, and articular.

The law is often an organized and methodical bewilderment. Lawyers are professional bewilderers who are occasionally accurate and truthful and then not always from virtue, but sometimes perhaps from necessity or deep design. They raise a cloud of dust to obscure the facts and then vainly try to find a way out. The Judge may be a self constituted oracle of surgical knowledge, an irritable repudiator of everything modern and reasonable, or he may sit in dignified isolation from all mundane annoyances and all irritating and contaminating truths. Medical witnesses are often partisan and controversial, are not very unusually inaccurate and unreliable, and are sometimes actually mendacious. Some of them cheerfully swear to things they would not bet on. The elder Dumas said that it is the book which it is impossible to read which creates a sensation. The same may be said of dinners it is impossible to eat, and of testimony it is impossible to understand. In the average damage suit there is much contradictory testimony from medical experts. Some of the testimony may have as little meaning as the frozen words which fell upon the deck of Pantagruel's ship. The Judge and jury, even if instigated by the best intentions, may pass into the deepest error and so the wrong may triumph. Surely a more stupid method of seeking truth and hence of obtaining justice could scarcely be devised. Such views will not be popular with lawyers and professional medical experts, but in the words of Paul to the Gallatians, "Am I become the enemy because I speak the truth?"

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* Read by title before the American Surgical Association, April 12, 1914.

In a Philadelphia case, in which it was claimed that the plaintiff suffered from traumatic tuberculosis of the lung, the learned judge, apparently indignant at the mere mention of such a thing, directed the jury "to exclude all evidence touching the question of traumatic tuberculosis as fully and conclusively as if none had been offered," maintaining that "the attribution of tuberculosis to trauma does not rise above the grade of a theory adopted by a small number (a most respectable number it is true) of one profession."[1] The judicial light above quoted calmly settled the whole question off-hand and without mental effort, and decreed that hereafter traumatic tuberculosis was to have no standing in court. Lawyers express surprise that medical experts ever disagree. Lawyers always disagree. There is at least one on each side of every case, the judge often disagrees with both of them, and the Supreme Court, which has the last guess (by a majority vote), often reverses the verdict of the lower court. In the case cited above, the Superior Court of Pennsylvania disagreed with the trial judge and reversed the judgment, declaring that the testimony relating to traumatic tuberculosis "should have been submitted to the jury for its consideration."[2] The Court said: "There is a clear distinction between the guess and conjecture that is inveighed against by some judges and some text writers, and the carefully formed opinion of capable, honest and eminent physicians."[3] In the trial of the case one expert testified that a man has eleven ribs. As Mark Twain said of Fennimore Cooper—he dealt "freely in important omissions." Perhaps he was seeking to justify the narrative in Genesis which tells of the creation of Eve. In the second trial a new medical witness was discovered by the defendant. He swore that he had attended the plaintiff three years before the accident and had a record of the case in his case book, and that long before the accident the claimant was the victim of pulmonary tuberculosis. In the first trial one expert swore that the relation between the injury as a cause and the existing condition of the patient was obvious, and unhesitatingly affirmed that the tuberculosis was caused by the injury. In the second trial some of his views had undergone a sort of benevolent assimilation from the outside. His revised statement was that nothing in the case independent of the history could lead him to regard the condition as "traumatic consumption." The judge in his charge attached great importance to the testimony of the witness who swore that he had attended the plaintiff long before the accident and had attended him for consumption, yet the jury brought in a large verdict for the plaintiff.

Such are some of the confusions relating to this subject. Such are some of the vagaries of judges, attorneys, expert witnesses, and jurors.

Because of the unsettled opinions and divergent views made evident by the case cited above it seems worth while to review and bring together what we do know about the alleged relationship between trauma and tuberculosis—to try to discriminate between known facts and wild guesses, between reasonable deductions and fanciful conjectures. The question is as follows: Is an injury ever a determining cause of a tuberculous lesion? We all know that tuberculosis may follow injury, but that one thing follows another thing is no proof that the first was the cause of the second. To prove that tuberculosis can result from an injury we must prove that injury has a tendency, under certain conditions, to determine lesions of tuberculosis.

Until 1882 the opinion was general that injury was causal of what they then called a scrofulous joint, a strumous joint, fungous arthritis or white swelling.

Erichsen[4] expressed the general view. In speaking of "strumous" joints he says: "This condition has not in many cases any definite starting point but appears slowly to supervene upon some slight injury, as a twist, or blow, or strain;

at other times it commences with a subacute synovitis, assuming its peculiar characters by occurring in a strumous constitution and is especially liable to happen in children and females." Samuel D. Gross [5] was one of the very few to emphatically deny a local origin of tuberculous joints. He considered the exciting causes to be "very obscure, if not utterly inscrutable. The surgeon is often told that the patient, perhaps weeks or months before the appearance of the characteristic phenomena, received some injury, as a blow, fall or kick, or that the affected joint had been sprained, bruised, or twisted, but such information is usually not trustworthy, or if such an occurrence did take place, it probably exerted little, if any, influence in developing the complaint." Gross named many conditions as predisposing causes, saying: "Whatever has a tendency to enfeeble the system or to derange the blood are so many predisposing causes of the disease, if they do not actually call it into activity." Among these alleged causes he mentioned typhoid fever, measels, small-pox, scarlatina, chronic diarrhœa, protracted courses of mercury, copious and repeated hemorrhages, chronic digestive disorder, unwholesome food, poor assimilation, imperfect nutrition, and infantile cholera.

We know in this day that some of the conditions mentioned by Gross did not produce tuberculous joints, but did produce special forms of joint disease not then identified. This is true, for instance, of typhoid fever. The other conditions could favor the development of tubercle in the body by lowering general body resistance but could have no power in determining its location in bone, joint or pulmonary tissue.

Max Schuller's [6] widely quoted experiments were made in 1880. They seemed to indicate the tuberculous nature and the frequent traumatic origin of "strumous synovitis." Schuller performed tracheotomy upon dogs and rabbits, injected tuberculous material through the tracheal openings and at the same time injured the right knee-joint of each animal. As a result some of the animals developed general tuberculosis and some a condition that appeared histologically to be tuberculosis of the damaged joint. In no instance did a joint which had not been injured become tuberculous.

Gibney, in 1877,[7] asserted that traumatism was causal in forty-two per cent. of his cases of joint tuberculosis.

Koenig[8] maintained the causal influence of trauma in at least half of the cases of tuberculous joints.

Téissier[9] believed that an injury of the chest followed by hæmoptysis might be responsible for the development of pulmonary consumption.

According to Oliver,[10] Perrond in 1875 claimed that the frequency of phthisis among the boatmen of the Rhone was due to the men "leaning with their chest wall upon the pole of the rudder in steering their ships. It was thought that the repeated pressure favored the development of pulmonary lesions, the interesting point being that the maximum focus of the disease, as revealed by auscultation, always appeared to be located at the level of the point of pressure by the pole, viz., under the right clavicle."

In 1882 Koch discovered the tubercle bacillus and this discovery strengthened the belief of all who denied the influence of traumatism in the production of local tuberculosis. They said: "the disease can be caused by the bacillus alone. Traumatism cannot cause the bacillus. Hence injury is casual, never causal."

W. Müller,[11] experimenting on the bones of goats, injected tubercle bacilli into the nutritive arteries without inflicting trauma on the bones and tuberculous osteomyelitis developed. This seemed like experimental proof of what every one knew, that the condition could develop without trauma. Lannelongue and Achard[12] injected tubercle bacilli into guinea-pigs and in from nineteen to twenty-one days later produced bone injury and joint damage, yet tuberculous disease did not arise in the damaged areas. In these cases the injuries were inflicted at too late a period after injections.

Friedrich[13] actually asserted that joints subjected to traumatism were less likely to become tuberculous than uninjured joints. Some corporations would be glad to pay money to have this view petrified into established law. It is worthy of note that Friedrich used attenuated cultures in his inoculations.

Frazer[14] by injecting bacilli into the nutritive arteries did not produce tuberculous osteomyelitis. Krause[15] injected guinea-pigs and rabbits with pure cultures of the bacilli. At the time of the injection or very soon afterwards, he broke a bone and injured a joint. In no case did the seat of fracture become tuberculous. In one-third of the guinea-pigs and one-half of the rabbits the injured joint became tuberculous. In only one case did a joint which was not injured become tuberculous.

Salvia[16] injected rabbits with virulent cultures and claimed that injury localized tubercle. Animal experiments are inconclusive and contradictory.

Drs. H. A. Wilson and Randle C. Rosenberger[17] say, "it is impossible to accurately compare animal experiments with the process as seen in human beings, for the reason that the means of infection employed in animals essentially differs from the infection of children. Animal experiments are wholly artificial, and necessarily so. Direct inoculation of a child's joint does not occur, nor is trauma of any kind ever applied in the manner resorted to in experimentation. The results of animal experimentation are therefore interesting, instructive, and illuminating, but too much reliance should not be placed upon them in determining a solution of the problem. Very little information is obtainable as to the kind of trauma that was employed in the experiments. It is impossible, therefore, to determine the relative value, as causative or contributory factors, of severe injuries, sprains, contusions, lacerations, bruises, indirect trauma and functional trauma."

At the present time some surgeons absolutely deny any relation between trauma and tuberculosis. Richard Stern[18] states that most surgeons, judging from clinical experience, deny that trauma is concerned in the development of osseous or articular tuberculosis and that if it appears to be, the bone or joint was previously tuberculous.

Nicholas Senn[19] in 1892 affirmed with emphasis that trauma can only be an exciting cause of tuberculosis of bone in a person "already infected with the essential cause." He did not say that a person must have a lesion of tuberculosis. He states specifically that the *bacilli* must be present in the *tissue* or in the *blood* at the time of the injury.

Wilson and Rosenberger[17] emphatically deny that trauma has any "existence in the etiology or in the beginning of the process" in bone or joint tuberculosis.

Many surgeons still affirm a relationship. All admit that a local quiescent focus may be lighted up by an injury. Nobody believes that injury under any circumstances causes the bacillus. Nobody believes that injury without the bacillus is under any circumstances capable of causing those tissue changes which we call tuberculous. What many do believe is that injury may determine the development of tuberculosis in a part previously free from lesion. Among the many surgeons who believe that injury may determine the development of tuberculosis we may mention Bradford and Lovett, W. Watson Cheyne, Nichols, Bryant, Sir Frederick Treves, Tillmanns, Golthwaite, Voss, and H. L. Taylor. Many medical writers never speak of the matter at all. Jacoud of Paris[20] in 1896 reported a case of phthisis which he believed to be due to traumatic pneumonia. Weir of Glasgow[21] reported a case of a man who was struck on the chest and developed pleurisy and finally phthisis. Some call this contusion tuberculosis.

Oliver[22] has seen cases which suggest "a causal connection between injury and tuberculous lung disease." Other observers have been convinced that tuberculous meningitis can follow a head injury (Waibel,[23] Ehrnrooth[24]). Traumatic tuberculosis of the breast and traumatic tuberculosis of the kidney have been described.

The relationship between injury and tuberculosis has been a subject of considerable debate in Germany since the promulgation of the workmen's compensation law in 1884. The new state insurance act must bring it to the front in England.

In the United States a horde of eager damage suit lawyers and a number of reluctant corporations are wrangling the question into prominence. It behooves surgeons to study the matter, to think it over with care and to reach definite conclusions.

In the ensuing discussion I shall consider particularly tuberculous bones and joints. Joint tuberculosis is the condition in which the relation between trauma and tuberculosis seems to be closest.

Tubercle bacilli are particularly prone to take lodgment in and produce disease of cancellous tissue. The period of greatest liability is during the first decade of life, particularly during the first five years, though during the first year the disease is rare. Considerable more than half of the cases occur before the twentieth year. Many cases occur in persons much beyond the twentieth year, middle aged victims are not rarities and even the senile are not immune. Sir James Paget saw a case in a man of ninety-one. In the first decade the condition is about equally common in males and females. After the first decade up to the age of sixty it is most common in males. After sixty the disease is equally common in both sexes. Hereditary predisposition is often noted in children. It is found in at least twenty-five per cent. of them. Inherited predisposition is far less commonly evident in adults. The prognosis in adults is decidedly worse than in children, suppuration is more apt to occur and sequestrum formation is a more usual consequence.

Howard Marsh says,[25] "Indeed recovery, when either the hip or the knee is attacked in patients between thirty and sixty-five, very rarely takes place." The prognosis is worse in males than in females. Death may be due to acute general tuberculosis, to tuberculosis of distant parts (lung, brain, genito-urinary organs, peritoneum), to exhaustion, or to lardaceous degeneration. Of W. Watson Cheyne's cases [26] only 4.4 per cent. died of tuberculous disease and only 10.8 per cent. suffered from phthisis or tuberculosis elsewhere.

In cases of bone and joint tuberculosis *demonstrable* tuberculosis of the lung is rare, in fact, the victims of supposedly primary tuberculosis disease of a bone or joint seldom develop active pulmonary tuberculosis.

Howard Marsh[25] says, "At the Alexandra Hospital, where there are always between sixty and seventy children under treatment for hip disease, and where the subsequent history of the case is, as far as possible, traced out, phthisis is so rare that sometimes a year passes without the development of more than two or three examples of it."

If tuberculous lesions exist in the lungs they are usually in "a comparatively dormant or recessive stage, and in the vast majority of instances do not progress, but clear up and disappear under treatment—and *pari passu*—with the improvement of the bone and the joint." (Woods Hutchinson.[27])

Old foci, often latent or regressive, may exist in the lungs or in lymph-glands. Cornet[28] tells us that out of 67 autopsies made by Orth in Gottingen, 53 showed distant foci but 14 cases were found free from any focus beyond the bone and joint.

Which joint is most commonly attacked? Most writers say the spine. During the 15 years, from 1885–1899, 7841 cases were treated at the Hospital for Ruptured and Crippled in New York City. Of these 3203 were instances of Pott's disease, 2230 of hip disease and the remaining 2408 cases comprised tuberculous disease of the other joints (quoted by Weeks[27]). The lower suffer much more frequently than the upper extremities. Age is certainly a factor in determining localization.

In early childhood hip disease is most common, but the knee runs it a close second. The shoulder is seldom attacked during the first decade. The hip seldom during the third decade and very seldom during the fourth decade.

W. Watson Cheyne[26] arranges "the various bones and joints in the following order of frequency of occurrence, from youth upward: hip; knee; ankle and elbow; tarsus; fingers; spine; shoulder; wrist; ribs. In order of frequency of occurrence during the first decade we have—hip; knee; spine; elbow; ankle; tarsus; fingers; wrist.

Statistics show that a considerable and perhaps a very large per cent. of all cases are preceded by injury and suggest that not a few cases in reality are directly determined by injury. Some surgeons have assigned injury as a cause in 53 per cent. of cases (C. F. Taylor, quoted by Wilson and Rosenberger[17]). Others have restricted the number of traumatic cases to 10 per cent. Whitman[29] combined the statistics of Koenig, Mikulicz, Bruns and Hildebrand, and thus obtained 3398 cases, 513 of which were described as traumatic.

Ribera Y. Sans[30] finds a record of antecedent trauma in 45 per cent. of cases of tuberculosis of the larger joints.

Koenig[8] believed that distinct traumatism preceded the disease in 50 per cent. of cases. Voss[31] set the percentage at twenty.

Bosanquet[32] says: "I think we must put disease of the joints in a class by itself. There is a considerable mass of evidence, that in some way or other injury does lead to tubercular arthritis." All statistics indicate that slight injuries are more often blamed than severe injuries. It is not a dislocation of a joint which is thought to be causal, but a sprain of a joint or a contusion of a ligament. It is not a fracture of a bone but a bruise of the periosteum or a strain of an epiphysis. Treves[33] says: "Another feature in tuberculosis is the trifling nature of the irritant or lesion whereby the mischief may be in the first place localized."

Statistics show conclusively that recognized trauma often precedes the disease. That trauma often precedes the disease does not prove that it causes the disease. The sequence is not of necessity a consequence. In order to prove that it is a consequence we must prove from known facts and justifiable deductions that an injury has a definite tendency to determine the development of the disease in a bone or in a joint.

All admit that a great number of cases arise without any record or sign of antecedent traumatism or preceding joint disease. This is thoroughly proved by such recorded cases as the following. A boy while in bed and under treatment for tuberculous disease of one hip developed the disease in the other hip.

A person in apparently robust health may develop the disease. Bonney[28] says: "I have had occasion to note in a rather surprising number of cases the so-called idiopathic development of tuberculous processes in bones and joints among adult robust farmers and others accustomed to physical activity in the open air."

All acknowledge that if there is an existing active focus of bone or joint tuberculosis an injury may aggravate the local condition and even disseminate the disease. An injury may prolong an illness, may convert a case tending to cure into a case tending to joint destruction or may convert a curable condition into a fatal malady.

The great importance all surgeons attach to rest in the treatment of tuberculous joints indicates the general conviction that even trivial traumatism may be detrimental or actually dangerous.

Forcible movement of a tuberculous joint is apt to be followed by articular destruction or the development of distant lesions. The patients who are not kept properly at rest are most apt to develop tuberculous meningitis or mixed infection of the joint.

All admit that a tuberculous lesion of a bone or joint may become latent and that such an arrest of the activity of a lesion is a long step on the road to cure. No one denies that an injury may light up into violent and perhaps destructive progress an area previously quiescent. Just this course of events is sometimes noted when a stiff joint containing latent foci of tuberculosis is subjected to forcible straightening. So far there has been no dispute. We have now reached the parting of the ways of opinion.

One school of surgical thought holds that osseous and articular tuberculosis is never primary, but is always secondary, and that when it is discovered after an injury, the injury was not in any sense causal of the disease, but merely aggravated a part already actively tuberculous or excited latent areas contained in the part into activity. In other words, it teaches that such a part was tuberculous before the accident and that the injury simply revealed an area of tuberculosis whose existence was previously unsuspected, or made more active an area of disease.

The other school holds that, while in most instances the disease is secondary in some it is certainly primary. It admits that in many cases the injury has merely aggravated a tuberculous lesion or awakened from dormancy a latent area, but claims that in some cases injury is the direct determining cause of the disease. In such cases the part was free from all tubercles before the accident but quickly developed them afterwards. In such cases tubercle bacilli but not tubercles were in the part at the time of the accident or were brought there soon after it in the body fluids, such bacilli coming from some distant and probably unrecognized area of disease or having entered into the lymph and blood directly after ingestion, inhalation or inoculation. How can an injury be responsible for determining the development of tuberculosis of bone or joint?

Various bacteria by various routes are ever entering into the body fluids. If the individual is in sound health they seldom live long in the fluids. Unless the number introduced is inordinately great, the bacteria are peculiarly malignant, or the defensive apparatus of the body is impaired in efficiency, the bacteria do no harm and are soon killed. Some organisms and some spores may, of course, become latent (typhoid bacilli, pneumococci, staphylococci, spirochætes), but as a general rule bacteria are soon killed when the individual's health is good and when they reach no area of tissue damage.

Vital resistance may be lowered generally. A number of organisms might produce no effect on a healthy man yet produce disease in a person ill-nourished, weak, debilitated by alcohol, diabetes or Bright's disease, shaken by fear or depressed by shock.

Vital resistance may be lowered locally. This may be brought about by disease, as when bronchitis lowers pulmonary resistance—or by injury, as when a hæmatoma becomes the seat of suppuration. A local region of lowered or impaired resistance is called *a point of least resistance.*

Injury ruptures vessels. In a slight injury a few very small vessels are ruptured, trivial and transitory hyperæmia arises and little or no stasis follows. Stasis occurs after more severe injuries but even when stasis occurs the area of stasis is surrounded by a zone of hyperæmia. If blood contains bacteria, then hyperæmia, which is a condition in which more blood passes through the part, means that more bacteria are brought to the part, and many of them pass out into the perivascular tissues through the ruptured vessels.

Bacteria which enter the damaged tissues linger and tend to remain. Bacteria while lingering may pass out through the damaged vessel walls into the perivascular tissues. Hence an injury causes bacteria which are in the blood to linger in the region of damage and causes many of them to leave the vessels and enter as prisoners into the tissues. When bacteria linger they are dangerous—when they enter the tissues they are menaces. Instead of being carried rapidly by the part, as would have been the case had there been no injury, they make a prolonged stay in the damaged area; during the prolonged stay, which was invited by the traumatism, they have time to batter down cellular resistance by means of their bacterial poisons.

It is well known that bacteria, which when in a part but a brief time do no harm, produce disease if retained. Nacrede[34] says: "Wegner and Grawitz have shown that the same number of germs, which when introduced into the peritoneal cavity will cause no trouble, because quickly removed by absorption, will produce a septic peritonitis if sterilized water be added to the pure culture. This so increases the bulk that a longer time is requisite for absorption, and hence a longer time is provided for the toxic substances to act locally; moreover, the inflammation usually starts at the point of original trauma, *i.e.,* the hypodermic needle puncture, the locus minoris resistantiæ."

Many years ago Chauveau pointed out that if a vein were injected with putrid fluid and a testicle crushed, the gland became the seat of septic gangrene.

Kocher showed that if an animal is fed upon putrid meat disease of bone does not arise unless the part is subjected to traumatism. If a bone is injured osteomyelitis is very apt to occur.

Nancrede[34] says: "The proof of these statements has been demonstrated by introducing into the circulation large numbers of the pyogenic cocci causative of osteomyelitis, whence they quickly disappear by means such as have been already, or will be later, explained. Repeat the inoculation, however, and then contuse or fracture a bone and promptly the microbes will be located and osteomyelitis will develop."

Every surgeon is familiar with the fact that osteomyelitis without a wound frequently follows traumatism and does so when there was no antecedent purulent focus in the bone. He is accustomed to search for a distant focus from which the cocci might have come. Sometimes he finds no such atrium of infection, at other times he finds a pyogenic focus in the pleura, the lung, the ear, the mouth, the tonsil, the prostate or the skin.

Nancrede [34] says, "A carious tooth, the lesions inflicted on the gums by the tooth-brush or tooth-pick, burns, scalds and damages of the buccal mucous membrane caused by the teeth, lesions of the nasal passages, and recently healed wounds, may any of them be the entrance point of microörganisms productive even of fatal pyemia."

The surgeon never doubts that the bone injury determined the origin of the osteomyelitis, not by causing the creation of pyogenic bacteria, but by creating a point of least resistance, where organisms which previously passed through linger or lodge. Because of the trauma organisms which would have proved futile for harm and would have gone to rapid destruction live, multiply and produce disease.

In 21 of Hahn's 41 cases of vertebral osteomyelitis there had been antecedent traumatism and in six of these cases Hahn regarded traumatism as certainly the cause.

Acute infectious arthritis of the hip is usually determined by injury. The colon bacillus does not harm the appendix unless that part is congested or obstructed, kinked, twisted or bruised. When resistance is thus lowered the colon bacillus causes appendicitis.

In typhoid the germs enter the blood and may remain there for some time. They tend to lie latent perhaps for a very long time in bone-marrow and yet may never cause disease. Traumatism will be followed by typhoid osteomyelitis. Trauma during or after typhoid may be responsible for typhoid spine. Traumatism of a bone in a syphilitic is followed by periostitis due to spirochætes. It is well known that empyema may follow contusion of the chest. That pyogenic cocci and various other microörganisms act in this way is not disputed. Is it unfair to assert that tubercle bacilli act in exactly the same way? They are so widely distributed, are so frequently taken into the body and are so hard to kill it would seem odd if they did not.

In fact, tubercle bacilli *do* act in the same way. They may enter blood and lymph from an active focus of disease, from a passive focus of disease, or directly by inhalation, ingestion, or inoculation without inducing disease at the point of entrance and when no known focus of disease exists. Latent lesions are most common in the bronchial and mesenteric glands, they tend to cure but may be raised into activity by some bodily disease or some injury. Even when not so goaded they may from time to time give bacteria to the system. We can seldom know that a latent lesion exists. Such a lesion is probably tuberculosis advancing toward cure.

Ravenel, Orth and others have shown that tubercle bacilli may pass through the wall of a normal intestine without causing any tell-tale lesion at the point of passage and may produce tuberculosis in the mesenteric lymph-glands or may remain latent in the nodes for a brief or for a considerable period of time. Bacilli may lie latent in glands even when the glands are not diseased. They are very tenacious of life. The fatty material or wax of the bacilli " has the faculty of resisting, in a special manner, the influence of the digestive juices, of the phagocytes, the cells which exterminate dangerous microbes, and are therefore defenders of the animal organism." [27]

Living bacilli have been found in the fæces of apparently healthy subjects. " It would seem rational to believe that the fæces, at least, would contain occasional tubercle bacilli carried into the mouth with the food or air, and thence into the digestive tract without infecting the patient." (Wilson and Rosenberger.[27]) Rosenberger has knowledge " of at least two cases in which we have found bacilli in the fæces, and in which, at autopsy, no macroscopical lesions of tuberculosis could be detected throughout the body. This does not mean, of course, that the patient may not have had an actual infection by tubercle bacilli at the time of examination of the fæces and the discovery of the bacilli." [27]

Various observers tell us that at ordinary temperatures the bacilli will live and remain virulent in water for several months (Rosenau [27]). They will live much longer and freely travel in blood and lymph and may never induce tuberculous lesions.

That they can live in blood has been proved. They can enter the blood from the food by way of the lymph taken up from the intestines. They may enter the lymph from inoculation and perhaps from inhalation, and from the lymph they enter the blood. They may enter the blood from an active or latent focus of disease. If soup containing tubercle bacilli is given to animals the bacteria reach the blood of the heart within five hours (Besanti and Panisset).

In what Landouzy [27] called typhobacillosis, the blood contains tubercle bacilli in numbers. They produce a septicæmic condition with positive symptoms, yet there may be no tuberculous lesion. If blood drawn from the vein of such a patient be injected into a guinea-pig the animal will develop tuberculosis.

The blood, even in a person devoid of any tuberculous lesion, must at times contain tubercle bacilli, which may linger long before dying, which may get into a gland or some other structure, there to remain latent or to induce disease. Tubercle bacilli have an affinity for special parts and tend to settle out into them (cancellous tissue of bone, lung, kidney, lymph-glands, and serous membranes). An injury tends strongly to localize bacteria. This is especially true of injury to certain bones. The lung is particularly predisposed by catarrh. The bone is particularly predisposed by trauma.

Slight injuries predispose much more decidedly than severe injuries. Volkmann called attention to this years ago. Rose and Carless[35] say that the bacilli find "a suitable breeding ground" in "bones and joints in a state of congestion resulting from slight and overlooked injuries." When a few small vessels are ruptured or thrombosed, when trivial hyperæmia arises and the vital activity of an area of cells is lowered, and when the bacilli are caught in the area, they will be apt to multiply and cause disease. In such a trivial injury says Nancrede,[34] "The hyperæmia is too limited to admit of the prompt arrival and accumulation of phagocytes and alexins." A severe injury "is productive of such cell-proliferation that it will hold in abeyance the pathogenic action of the bacilli which might reach the seat of injury with the extravasated blood." (Senn.[19]) After a severe injury the more prolonged hyperæmia permits of a prompt arrival of phagocytes and alexins. In a severe injury retardation and stasis become marked and in this condition phagocytes in numbers and germicidal materials pass into the perivascular tissues. Traumatic cases are commoner in adults than in children. Traumatic cases give a worse prognosis than non-traumatic cases. Disorganization is more common, mixed infection is more usual and dissemination is more apt to take place.

In a case of tuberculous arthritis, if the reality of the accident is proved, if from the time of the accident there continued to be some pain and stiffness in the part and if the symptoms suggestive of tuberculosis arise at a period not over three months from the accident we are justified in regarding the trauma as having been causal (Bosanquet[32]).

When a surgeon suspects the existence of a tuberculous joint he should always have an X-ray picture taken. Changes will be visible when the bacilli have attacked the blood-vessels and have produced nodules which destroy the medullary tissue.

In young children when the extremities of the bone are cartilaginous the X-rays will not be nearly so valuable in aiding early diagnosis as they are in adults. Whenever bone destruction has occurred the X-rays will show disease. The significance of bone changes should be interpreted by an expert.

The fact that not very unusually joints when skiagraphed very soon after an accident show no trace of tubercle and yet in a few weeks or months have become obviously tuberculous, suggests, though it does not prove, that such joints contained no old foci of disease, that the injury did more than merely aggravate an active focus or rouse a dormant area and was in reality the determining cause of the joint disease. In every case of articular tuberculosis a surgeon seeks carefully for a primary focus. He may find it in a gland, lung, in the abdomen or in another articulation. In very many cases he cannot find it. In such a case there may be no other lesion or there may be a latent area. If there is a latent area it is giving no symptoms and is probably on the road to cure. An unrecognizable latent area may be raised into activity by a traumatism inflicted at the same time as the articular injury, by cold, by shock, by exhaustion, by fear, by confinement to the house, or by the development of some complicating disease. Among the objections raised to the view that traumatism may be a determining cause of articular tuberculosis are the following:

1. That a slight injury cannot be responsible when a severe injury is not. Wilson and Rosenberger[17] say: "It is inconceivable that lesser injuries should do what greater injuries fail to do." Nevertheless, the statement that a slight injury does what a severe injury fails to do is true of typhoid disease of bones and joints—of osseous gummata—and of many cases of pyogenic osteomyelitis.

Bone sarcoma is more common after contusions than after fractures.

Few dispute that tuberculous thecitis may follow injury. In such a case the injury is more often trivial than violent. Why should the occurrence be inconceivable in a tuberculous bone or joint when exactly the same thing is noted, and when it is accepted in tuberculous thecitis and various other conditions? As previously stated a severe injury promptly brings quantities of phagocytes and alexins, establishes stasis which is antagonistic to tubercle, and causes active cell proliferation.

A mild injury produces limited hyperæmia. Few phagocytes are available and little alexin arrives, there is little or no protective stasis and the tissue defences are not aroused to exert an effort at self protection.

2. Because the lower extremities suffer most often from tuberculosis but are least often injured, it is urged that injury cannot be causal. As a matter of fact, the larger joints are in the lower extremities, the larger joints are apt to suffer from slight injuries, and the larger joints are most often the seat of tuberculosis after injury.

The knee is the most common seat of supposed traumatic tuberculosis.

In some other diseases of bone and joint the same predilection is shown for the lower extremities.

The femur and tibia are most prone to osteomyelitis and I know of no denial that traumatism may be the determining cause of this disease. The same is true of typhoid disease of the bones and joints. Syphilis seldom attacks the smaller bones, but is notably common in the tibia.

3. That there are many injuries of bones and joints but comparatively few cases of tuberculous disease is looked upon by some as a conclusive fact against a traumatic origin of that disease. The argument is merely equivalent to saying that there are many winds but comparatively few shipwrecks, hence wind cannot cause a wreck—that there are many fogs but few railroad collisions, hence fog cannot be responsible for collision—that there are many falls but few fractures, hence a fall cannot break a bone.

4. The way nature protects the joints is regarded by some as indicating that slight traumatisms are unusual; for example, the knee. " In falling and striking the knee the tuberosity of the tibia receives the impact, while the patella and the entire knee escape direct injury, and yet the condyles of the femur are far more frequently the original site of tuberculosis than the tibia." (Wilson and Rosenberger.[17]) There are at

least three answers to this statement. In the young strain of an epiphysis is a common cause and the femoral epiphysis may be strained when the tibia is contused. Muscular or ligamentous strain may be responsible, as it is known to be in typhoid spine.

The impairment of the normal activity of the part due to the injury is responsible for trauma during functionation. This is known as " functional trauma," and functional trauma may be causal as truly as strain or contusion from the accident.

5. Some assert that as mechanical stasis tends to cure tuberculosis and as injury causes stasis, injury could not determine tuberculosis. Those who put forth this assertion should go to the logical conclusion and claim that injury of a tuberculous part would cure the disease. As a matter of fact, stasis produced by the rubber band (Bier's method) is not identical with inflammatory stasis. Further, in very slight injuries there is no stasis or very slight and temporary stasis, and it is very slight injuries which are most often to blame.

I believe that it is as certain as many things medical can be that traumatism is often a determining cause of bone and articular tuberculosis and sometimes of tuberculosis in other regions. This view is held by numbers of able and eminent clinicians and should be recognized by all courts of law.

I have seen many cases which I regard as traumatic tuberculosis of bones and of joints, and a number of cases of traumatic tuberculosis of tendon sheaths. A striking case of bone tuberculosis occurring in my practice was disease of the sacroiliac joint arising in a sturdy miner after a wrench. There was never any evidence of any other focus. Cure followed operation.

I have seen a number of cases of traumatic tuberculosis in the knee, foot, and wrist and several in the hip. I have seen tuberculosis of the inguinal glands after a kick, tuberculosis of the epididymis after a bruise, tuberculosis of the kidney after contusion of that organ, and tuberculosis of the mammary gland after a blow.

A fireman in first class physical condition fell from a roof and fractured several ribs on the right side. Pleuritis arose, traumatic pneumonia with hemorrhage developed, and later the man died of pulmonary tuberculosis. A post mortem made by the coroner's physician disclosed the fact that the oldest pulmonary lesions were near the bruise and directly under the adherent pleura and the injured ribs. The man's family was given a pension, and in the Philadelphia Fire Department a pension is paid only when death is regarded as having been directly due to an injury.

To deny the possibility of traumatic tuberculosis is to deny many of the truths of pathology and some of the plainest lessons of clinical surgery.

The possibility of traumatic tuberculosis is a necessary deduction from acknowledged facts. To affirm it seems consistent, reasonable and, in fact, unavoidable even though the affirmation outrages the sensibilities and stirs the indignation of numerous corporation attorneys, who, in the words of Milton—"Ground their purposes not on the prudent and heavenly contemplation of justice and equity, but on the promising and pleasing thoughts of litigious terms, fat contentions and flowing fees."

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UNCOMPLICATED TUBERCULOUS FOCI IN BONES AND THEIR TREATMENT.

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THE term, uncomplicated tuberculosis bone foci, has reference to those cases in which the focus exists (*a*) as an incipient lesion, but sufficiently advanced to cause symptoms, and suggest diagnosis, (*b*) as a lesion which has resumed activity after a period of quiescence, with a renewal of characteristic symptoms. *In neither case has it become the seat of a mixed infection, nor has it invaded the adjacent joint.*

The promise of the orthopædist in dealing with lesions of this type, is based upon the belief that conservatism is his best if not only reliance.

I have always been skeptical regarding permanent cure of bone tuberculosis by orthopædic measures; rest, fixation, traction and general systemic measures. Later observation and experience have confirmed my earlier belief. In a word, I do not accept the doctrine of the final efficiency of conservatism, and have been in search of a more rational solution of a much mooted question through early, radical interference.

In a paper upon "The Operative Treatment of Hip-joint Disease,"[1] I said, "In the entire category of surgical experiences, there is nothing more pathetic and disheartening than the humiliating failures which have followed prolonged, painstaking efforts of skilful men in this department of surgery."

John L. Porter of Chicago, writing from the stand-point of the orthopædist, says,[2] "I doubt if there is any surgical disease which has been the subject of so much controversy, or which has been subjected to such wide diversity of methods in treatment, as tuberculosis of joints, but it seems to me that each year brings a little more unanimity of opinion; that we find ourselves discarding suggestions of doubtful value and are treating each case in accordance with its own indications rather than by a method of fixed routine."

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[1] Am. Journal Medical Sciences, July, 1905.

[2] Surg., Gynecol. and Obstetrics, 1913, vol. xvi, p. 334.

He maintains (*a*) that tuberculosis of joints in normal persons is a self-limited disease; (*b*) that in untreated cases the results are deformity and disability; (*c*) that the degree of deformity and disability depends upon the extent of time and duration of treatment.

As to the last factor he says that out of many hundreds of patients a few were well in one year, more required three years, and a larger number from three to five years. He makes no mention of unsatisfactory results nor mortality rate.

Speaking of early operation, as advocated by Ely and that which I have suggested, he says, " While these may be of value in certain selected cases, it is doubtful if they are advisable as routine methods."

Very significant are the observations of Chas. F. Painter of Boston.[3] Painter asserts that a tuberculous lesion is a constant menace to its possessor long after an apparent cure has been affected. He frankly questions the correctness of diagnosis in certain cases in the statement that many of the best results in cured cases are probably not tuberculosis.

He dwells upon the fact that tubercle bacilli live indefinitely in an encapsulated area, and fears recrudescence after the lapse of a variable interval. He states that during the past eight years 130 cases of " Pott's " and 180 cases of hip-joint disease were treated at the Kearney Hospital Clinic. A very considerable number of these cases came for secondary treatment after an interval of quiescence.

To these Painter applies the term " malignant " (recurring), and endorses the statement of Barker and Croft: that cures reported in orthopædic statistics are wholly unreliable.

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[3] Trans. of Am. Orthopedic Assn., 1902, " Malignancy of Joint Tuberculosis."

He warns patients who are cured by ordinary methods of the tendency to recurrence and insists that abatement of symptoms is in no sense an assurance against later trouble.

He expresses the opinion "that exploratory interference, with a view to removal of isolated foci in children is often advisable, and is to be urged in a majority of the recrudescences if seen early."

These views regarding the clinical history of bone and joint tuberculosis are fully in accord with my own. Repeated reference by many orthopædic writers to the protracted struggle for quiescence and apparent cure is of extreme interest, and in my opinion suggests to the general surgeon the propriety of assuming jurisdiction in a field uniformly conceded to the orthopædic specialist.

Latency as applied to bone tuberculosis, as to other surgical conditions, is a word to juggle with, and to my mind is little short of a misnomer. There seems to be a close analogy between tuberculous foci and a considerable pathological group, such as gall-bladder disease, chronic appendicitis and renal lithiasis.

No fact is better established than that alleged latency in this latter group is based upon error and is perniciously misleading. That insidiously progressive and harmful changes occur during a period of alleged latency in gall-bladder disease is beyond question.

To leave an accessible tuberculous bone focus, whether isolated or not, to smoulder until provoked to renewed activity at a later period is without justification, and seems to do violence to surgical principles. Certainly such a course in the presence of an osteomyelitis due to ordinary pathogens would be reprehensible. Can it be otherwise than true that thorough removal of the focus and surrounding tissue is as logical for tuberculous as for ordinary osteomyelitis?

Brackett of Boston, editorially in the *Am. Jour. of Orthopædic Surgery,* says, "It is not to be expected that surgery, meaning operative surgery, will replace conservatism, but it is to be hoped that it will shorten the long and disastrous periods of conservative methods; disastrous because of the almost waste of time in years of disability and the danger accruing to general health."

It is a matter of regret that so eminent an authority did not further elucidate his plan and explain by what technic he hopes to avoid the "almost waste of time" and prevent some of the disastrous consequences of pure conservatism.

It is a fact that resort to operative treatment has rarely been looked upon with favor during that interesting and critical period which goes before extensive invasion and joint destruction. On the contrary, radical treatment has been appealed to after conservatism has failed and when grave complications have rendered desperate measures inevitable.

The propriety of operative interference, with reference to radical cure during incipiency, depends upon two factors: (*a*) Early diagnosis; (*b*) accurate localization of the focus.

The former requirement is fundamental. The clinical history and symptom complex, together with tuberculin reactions and local joint conditions will furnish sufficient data on which to base a tentative opinion. Buxton[4] says emphatically: "The easier the diagnosis, the worse the prognosis. This applies more aptly to the treatment of this condition than to any other human ailment."

The possibility of lues must be carefully considered, and each case must be studied with reference to the acute conditions due to ordinary pathogens.

Localization in very early cases is a matter of some difficulty and may be impossible. Primarily, we know that in those bones most commonly affected, certain areas are a favorite seat of implantation. Persistent pain and tenderness over a circumscribed area are significant as pointing to the seat of disease. With fair assurance that an accessible focus lies beneath the cortex within reasonable limitations, the operator need not be too precise as to its exact anatomical relations.

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[4] Va. Med. Semi-Monthly, November, 1913.

But final localization in obscure cases must be deferred until the focus can be identified in the radiogram.

I wish to insist that in the acute, fulminating cases delay for any purpose is extremely hazardous, and that to this type, if to no other, early incision and evacuation offers peculiar advantages.

The objects to be obtained by early, direct interference are: (*a*) Permanent cure by elimination of the focus; (*b*) reduction of time of treatment from years to months; (*c*) prevention of complications, such as abscess formation, mixed infection, disintegration of bone and joint structures, crippling deformity and loss of function; (*d*) avoidance of systemic invasion and loss of life.

Operative technic is usually simple. Every exaction in the interest of asepticity must be observed. The most available extra-articular route is to be chosen. A rather liberal incision is carried to and through the periosteum. A sufficient area of bone is exposed over the suspected part. With a trephine or chisel the cortex is removed until the opening affords easy access to the marrow. With a strong, sharp curette the end of the bone is converted into a shell-like cavity, whose dimensions must depend upon the judgment and tactile sense of the operator.

The propriety of interfering with the epiphyseal cartilage has been questioned, particularly in the very young. My opinion is that if the disease has extended from its original location across this cartilage not much respect need be paid to it; if in the remote side it will naturally be preserved. Utmost care must be exercised to avoid perforation of the cortex so as to communicate with the synovial cavity.

The resulting chamber may be dealt with variously.

Sherman of San Francisco, after a liberal application of pure carbolic acid and alcohol, fills the cavity with normal salt solution, and closes the wound in tiers. In a series of uncomplicated cases, he has not had a failure and he commends the method strongly.

I have generally depended upon camphor phenol gauze packing (phenol one part, gum camphor three parts). The gauze is wrung dry and closely packed into the cavity. A few days later the amount of gauze is lessened and a little later is discarded. Such wounds heal rapidly and all discharge ceases in less than a fortnight under an aseptic dressing.

The great value of camphor phenol as an antiseptic is in the presence of infections, and as a safeguard in clean, open wounds seems not to be generally understood.

After removal of the initial dressing the cavity is usually free from blood, and can be filled with Beck's paste or the Mosetig-Moorhof wax. The wound may then be closed in the usual manner and fixation secured by a rather loosely applied plaster-of-Paris dressing.

I am able to report sixteen cases in which I have pursued the plan herein described, as follows: upper end of femur, three; lower end of femur, five; upper end of tibia, four; internal malleolus, two; lower end of radius, two.

In three of the operations upon the condyles of the femur, wound infection was encountered and convalescence delayed. In no case was the end result unsatisfactory, either from the stand-point of serious loss of function or of recrudescence. The mixed infections were encountered during my earlier experiences, when technic was far from perfect. The history of these cases is in marked contrast to manifold experiences had in late suppurating conditions.

I have been deeply impressed throughout with the fact that the sooner operative treatment was undertaken after diagnosis and localization, the simpler was the procedure, the shorter the time of convalescence and less was the degree of loss of function.

Attention is especially called to the three hip-joint cases noted above, in which my interest has centred, and which are already in the literature.[5]

Following the suggestion of Macnamara,[6] I proceeded to tunnel into the neck of the femur, through a trephine opening below the great trochanter, thereby removing most of the soft content of the neck. In one instance it was necessary to repeat the operation after a lapse of two weeks. At this time the epiphyseal cartilage was perforated, though but a small part of the head of the bone was removed.

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[5] Am. Jour. Med. Sciences, July, 1905; Surgery, Gynecology and Obstetrics, April, 1906; Surgery, Gynecology and Obstetrics, October, 1911.

[6] Disease of Bones and Joints, 1881.

The diagnosis in the three cases which constitute my series has been sharply questioned.

Heredity in every instance pointed to tuberculosis, and in one (a fulminating case) the patient suffered from a tuberculous lesion in the apex. The clinical history was most convincing. These patients are accessible and have been closely observed. All were well without recrudescence after a lapse of eleven, ten and eight years respectively. The average time of treatment about six months. One patient left the hospital in one month and was reported well in two months.

The functional results are as follows: One has nearly one inch shortening with motion through an angle of 35 degrees. This patient left my care permanently at the end of one month. It is fair to assume that the loss of joint function could have been measurably lessened by careful attention subsequent to the operation.

The second case has one-half inch shortening with nearly perfect function.

The third case has neither shortening nor loss of function.

Henning Waldenstrom of Stockholm,[7] with a large experience, is an ardent advocate of extracapsular removal of the focus. He has devised what he calls " a prophylactic operation." With a slightly different technic he accomplishes a purpose similar to my own.

Sherman's experience in this field leads him to justify the method, but he insists that a focus must be localized within narrow limitations before attempting relief. In at least four cases he has succeeded admirably.

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[7] Monograph: " Tuberculosis of the Hip in Children," 1910.

FRONTAL SINUS SUPPURATION.*

THE ESTABLISHMENT OF PERMANENT NASAL DRAINAGE; THE CLOSURE OF EXTERNAL FISTULÆ; EPIDERMIZATION OF SINUS.

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The logical treatment of most pathologic conditions is based upon an understanding of the cause. The condition with which we have to deal is that of chronic suppuration in a natural bony cavity which has a single small opening. We have to contend with changes produced by bacterial action and by mechanical obstruction.

Pathology.—1. *Acute catarrhal inflammation:* Following an attack of acute coryza, it is very common to observe an acute inflammation in the accessory sinuses, of which the frontal sinus is no exception. Its course is generally moderate and it is followed by complete resolution. If the ostium becomes occluded, an abscess or acute empyema may follow. This complication is more serious and the pus must escape sooner or later. This may be relieved by surgical intervention, or some wall of the sinus may ulcerate through, or relief may be spontaneous through the natural opening. Chronic suppuration is not an uncommon sequence.

2. *Chronic catarrhal inflammation:* This is a comparatively common condition, manifested clinically by the presence of pus in the middle meatus, together with certain subjective, and sometimes other objective, signs which it is not the aim of this paper to consider. The pathologic changes are of great importance. The mucous membrane of the sinus undergoes the changes common to any mucous membrane which is the seat of a chronic inflammation. It becomes thickened from œdema and connective tissue proliferation, the surface is irregular and sometimes ulcerating, and there may be polypoid growths sufficient to fill and cause pressure within the sinus.

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* Read before the American Surgical Association, April, 1914.

The ciliated epithelium is often destroyed. The ostium is more or less obstructed so as to impair drainage permanently. In some instances the periosteum and bone may be involved but such is the exceptional result.

The subsequent course will depend upon the degree and length of time of the obstruction and also upon the nature of the secondary changes in the mucous membrane.

TREATMENT.—The problem of the treatment of suppuration in any cavity depends upon the nature of the anatomic and pathologic conditions. Let us consider the general underlying principles which govern the treatment of suppuration in the various kinds of cavities.

1. *In Soft Tissues.*—If pus is evacuated from an abscess or cellulitis and efficient drainage is provided, the abscess wall collapses, the cavity becomes smaller and gradually closes from the bottom and, in a comparatively short time, the parts are healed. The closing progresses from the depths to the surface. This is what happens even in the closing of suppurating cavities within the abdomen, and we all know to our discomfort what it means to have the opening in the abdominal wall close before the deeper parts of the suppurating cavity are practically obliterated.

2. *Suppuration in Cavities with Partially Rigid Walls.*—Suppuration in the pleural cavity—empyema—is a type. The cavity is made by the pus crowding the lung. In the cases operated upon early with the establishment of suitable drainage, maintained continuously until the lung gradually expands and thus obliterates the cavity, a cure is obtained.

In the chronic cases excessive adhesions and connective tissue formation tend to prevent lung expansion. Such cases may fail to heal, although the drainage be ample, because a large cavity with suppurating walls persists. In rare cases, under such conditions, relief may be afforded by decortication or better by causing the rigid and almost unyielding chest wall to sink in to meet the lung and thus obliterate the cavity. This is accomplished by extensive rib excision. Hence, suppuration in the pleural cavity will persist until the cavity is obliterated by one means or another but, if not obliterated, the subsequent course will depend upon the facility with which it drains. If the opening becomes occluded too early, acute symptoms follow; if it remains patent, the discharge continues indefinitely, varying in amount more or less according to the size of the cavity and the freedom of drainage.

3. *Suppuration in Bony Cavities with Entirely Rigid Walls.*—(*a*) Unnatural cavities, for example, in osteomyelitis of long bones. Relief is obtained only after sequestra have been removed and the cavity obliterated by granulation tissue—healing from the bottom. In the shaft of long bones the healing may take place without much subsequent scar or bony defect, but at an enlarged extremity, as, for example, the upper end of the tibia, the extensive loss of cancellated structure may leave only the cortex as a rigid wall of a chronic suppurating cavity. Destruction of this cortex, in order to obliterate such a cavity, would mean a fractured leg, which of course would be an unjustifiable procedure. Some cavities of this sort never heal, some become epidermized after a very long period, leaving a more or less deep depression, and, in rare cases, a cavity may be obliterated by some sort of graft. Much of the cell structure of the mastoid, when inflamed, presents the same situation. In all the above examples of suppurating cavities, healing takes place only by obliteration of the cavity.

(*b*) *Suppuration in natural bony cavities.* Such cavities occur only in the head; they are lined with mucous membrane and communicate externally through the ear or nose. Frequently, they are the site of chronic inflammation. Relief may be obtained by efficient drainage, resulting in complete resolution, or by obliteration of the cavity, or, in a measure, by a combination of these methods, in cases where it is either unwise or impossible to entirely obliterate the cavity.

The frontal sinus is a natural cavity with rigid bony walls and the problem of treatment of suppuration depends upon anatomic and pathologic conditions. The chances of cure and differences in cosmetic effects vary according to the mode of treatment.

Let us now consider some of the methods used for the treatment of these cases.

Acute Catarrhal Inflammation of the Frontal Sinus.—This paper concerns chiefly the treatment of the more obstinate cases of chronic suppuration. In passing, however, let it be said that various degrees of acute inflammation are very common, but most of these resolve spontaneously in the course of a few days without particular treatment. Very occasionally, comparatively speaking, the ostium becomes occluded and abscess with perforating of a sinus wall results, but very often, after repeated exacerbations, the process becomes chronic and some sort of surgical interference is necessary.

Let us review briefly the principles underlying the chief operative measures for the relief of chronic frontal sinus suppuration. These may be classified as (1) intranasal operations and (2) extranasal operations.

(1) *Intranasal Operations.*—Certain anatomic features will be discussed in detail later, but, suffice it to say here, that the sinus drains through a comparatively small opening in its floor in close proximity to several anterior ethmoid cells and the extreme upper front portion of the middle turbinate bone. Attempts to cure all chronic cases should be made first by intranasal methods. These consist in the removal of the anterior portion of the middle turbinate and the breaking up of as many anterior cells as possible, the object being to establish free drainage. Many patients obtain satisfactory relief by this means. Attempts may be made to probe the sinus but there is always some doubt as to the success of such attempts, for reasons so frequently recorded by anatomists and clinicians. More radical intranasal methods are recommended and practised by some. These include the operations which aim to enlarge the frontal opening by means of burr drills and different types of raspatories, aided by the use of shields of different shapes and other guides to prevent injury to the bone posterior to the ostium. It is possible to probe some sinuses and then to enlarge the bony opening by these methods and obtain beneficial results. On the other hand, it is perfectly

obvious in the greater number of cases that the probe is not positively in the sinus and that the operator has absolutely no means of knowing the bony relations and, therefore, can never be reasonably sure of just what he is doing. The distances around the ostium are so short, the portions of bone to be removed so thick, and the bone protecting the dangerous structures so thin, that I am firmly convinced that what amounts to "blind operating" is unwise, particularly when there are other methods which allow of a certain amount of vision. These more radical intranasal methods involve far greater risk to life, for reasons so often detailed by others, than the external operations in which we are better able to see just what is being done. Furthermore, I believe that all very radical operations for the cure of chronic suppuration are serious and should not be looked upon lightly. The parts are so small and the importance of removing all bone around the ostium so great, that I believe it can be accomplished only by the aid of vision, which ensures both precision and safety. Hence, to summarize, I would say that, primarily, in all cases the front of the middle turbinate and all cells and growths in the vicinity lying below the ostium should be carefully removed and then some weeks allowed to elapse in the hope that a satisfactory cure will follow. Although I think that the complete removal of the nasal floor of the sinus is the essential factor in the cure of these cases, I believe that the nasal route is inefficient and unnecessarily dangerous even in skilled hands.

(2) *Extranasal Operations.*—The object of all operations is to cure the condition. There are two general types of extranasal methods; one aims to enlarge the natural opening and the other is a destructive method which aims to obliterate the sinus. Some methods tend to combine these principles. It seems to me that most of the very radical methods simply offer different degrees of exposure of the sinus, and, if the sinus is one that cannot be obliterated, a cure does not follow because the essential cause is not removed. In other words, the removal of large portions of the facial and orbital walls does not affect the size of the region of the ostium where the

opportunity for enlargement is none too good at best. However, this general removal of surfaces does do good and in many cases is followed by satisfactory healing because the sinus is practically obliterated or made so small that it is no longer troublesome, but the cosmetic results are unsatisfactory.

(*a*) *Operations to reëstablish drainage:* The Ogston-Luc operation, described by the former in 1884 and modified by the latter in 1894, is essentially a curetting of the cells around and below the ostium, chiefly through an opening in the facial wall. Modifications consist in the use or not of different types of temporary nasal or external drainage, but, finally, events must be left to take a natural course. Relief might follow but failures have been so common that more radical measures were adopted. Failure was, of course, due to recurrence of obstruction at the ostium, sometimes followed by an external fistula. Although the Ogston-Luc operation has been given up largely for the more destructive methods, its conception was in the right direction so far as combining a cure and good cosmetic results is concerned.

In this group we have also various osteoplastic resections combined with curetting around the ostium, one of which the writer devised and published in 1898. I believe these are unwise because it is not good technic to attempt plastic bone surgery around such suppurating cavities. The risk of spreading infection is great, the flap of bone is prone to necrosis because of the lack of nutrition, and its loss is followed by unnecessary deformity.

(*b*) *Efforts to obliterate the sinus:* Most of these operations combine a certain amount of curetting of ethmoid cells with that of the whole sinus; some do not disturb the floor of the sinus.

In 1894, Kunt suggested the removal of the facial wall so as to allow the skin to come in contact with the cerebral wall of the sinus; this would fail to obliterate a deep sinus.

Jansen's plan, formulated in 1893, was to remove the orbital floor; this would not obliterate a high sinus.

In 1898, Riedel resected both facial and orbital walls; this was more likely to obliterate the sinus, but the deformity is very marked.

In these attempts at obliteration, obstinate and troublesome pockets of pus persist in distal portions of large sinuses, so that suppuration and fistulæ continue.

In 1902, Killian suggested the resection of the orbital and facial walls, including a considerable portion of the nasal process of the superior maxilla, but left a bridge of bone along the supra-orbital arch so as to lessen the subsequent deformity. He includes also a thorough curetting of the neighboring cells and removal of a portion of the nasal crest of the frontal bone.

These four methods represent the general types of obliterative operations and various modifications of each have been devised. The Killian is the most radical and probably gives the greater percentage of cures. Failures are not uncommon and even here eventual deformity and occasional sequelæ persist. In the Killian method, if the sinus cannot be obliterated, the avenue of escape of exudate into the nose is narrowed because the soft parts fall in and are drawn in by scar tissue at the level of the site of the ostium because the support given by the upper portions of the nasal process and lachrymal bones is gone. Although one sees it stated frequently that the Killian operation is the final word in frontal sinus operations, still the results demonstrate that there is much more to be desired.

Some General Considerations.—The essential cause of continued frontal sinus suppuration is inadequate drainage which, in turn, may be followed by aggravating complications. Relief may be obtained by obliterating the sinus, or by establishing adequate drainage. The former cannot always be accomplished and it invariably results in objectionable deformity. On the other hand, it is not easy to obtain the desired amount of drainage. We must decide in each case, considering all the evidence at hand, whether we shall endeavor to obliterate the sinus or provide adequate drainage. The larger the sinus, the more difficult will be the task of obliterating it, and the more objectionable will be the deformity. On the other hand, the larger sinus is more easily drained and open to subsequent intranasal treatment, which is required after most sinus operations. If we can obtain a cure without bony deformity, this of course is desirable. In a general way, the larger the sinus the more trouble it causes, because of its increased area for suppuration and its greater capacity for granulations and polypi. The technic to be described seems to me to be particularly indicated when the sinus is large, when both sinuses are affected, or when an external fistula is present, and it should afford relief also after other methods have failed. The method avoids injury to the orbital contents, such as result in cellulitis, double vision, and inflammation of the lachrymal sac. It ensures easy access for the subsequent treatment of granulations, while the distal narrow angles and borders tend to become obliterated by scar tissue and the size of the new ostium, which can readily be kept open, prevents the retention of exudate until, finally, the remaining walls of the sinus cease to give rise to exudate and become covered with smooth scar tissue or mucous membrane. The ostium can be made actually as large as the anatomy will allow while the natural bony outline is preserved. If we are striving to get drainage, then I believe that the principle of the Killian and such operations is at fault, because, by the removal of the upper portion of the lachrymal bone, the nasal process, and the immediate adjacent part of the frontal bone, we take away bony support just where we need it and thereby allow the soft parts to fall in and be drawn in by contraction at a point where every fraction of an inch is most valuable.

The various external operations differ chiefly in the method of approach to the sinus, but the real issue is that of efficient drainage.

Hence, if the intranasal efforts for drainage described above fail, I believe we should attempt to establish it by the use of a method which is a combination of both the internal and external routes.

ANATOMY.—In considering the anatomy of the frontal sinus, the description will be limited to the structure and topography of those portions which are of practical importance in carrying out the technic of operation to be described later. Some years ago the writer published in detail the descriptive anatomy of this sinus and the anterior ethmoid cells (see Frontal Sinus and also Turbinate articles), but the following features are more particularly of operative importance.

All of the sinus is in the frontal bone. The sinuses vary in shape and size but, in a general way, present three surfaces and a base. The inner portion of the base and the posterior angle are situated above the extreme anterior portion of the nasal cavity and some of the anterior ethmoid cells (Figs. 9 and 17). The *posterior* or cerebral wall is in front of the frontal lobe of the brain and, although comparatively thin, the bone is dense in structure and not easily injured. This wall should be carefully avoided. The *anterior* or facial wall is the thickest, is more or less cancellated, and is the avenue of approach in most of the so-called external operations. Its extent, thickness and outline vary according to the size and shape of the sinus. The usual exploratory opening is made a little above the extremity of the nasal process of the superior maxilla (Figs. 1, 2 and 19), because the smallest sinus occupies this position. Very thick bone at this point is an indication that the sinus must be very small and does not rise to this level. For practical purposes such a sinus amounts to no more than an ethmoid cell and, of itself, could not be of much pathologic importance.

The *floor of the sinus* is of the greatest surgical importance and consists of an outer or orbital portion, and an inner or nasal portion (Figs. 1, 7, 8 and 11). The orbital portion is comparatively thin but dense. It has an attachment below for the pulley of the external oblique muscle, the dislodgment of which is undesirable. The more or less complete removal of the facial and this portion of the floor of the sinus is carried out in some operations directed toward the obliteration of the sinus, resulting in deformity according to the size of the sinus and the method adopted. The size and shape of some sinuses preclude obliteration.

The nasal portion contains the single ostium (Figs. 15 and

17) leading to the nose, and is made up of both very thin and very thick areas of bone. It is bounded externally by the suture between the lachrymal and frontal bones and somewhat by the suture between the nasal process and the frontal bone (Figs. 1, 7, 8 and 17). Internally it is bounded by the interfrontal septum, which is the upward projection of the plane of the nasal septum, although it may not necessarily be in the median line (Figs. 5, 11, 13 and 17). In front the boundary lies roughly behind the upper border of the nasal bone and the nasal process of the superior maxilla (Figs. 8 and 9). Although these bones do not form part of the wall of the sinus, they bear an important surgical relation to its floor. Posteriorly, the floor of the nasal portion comes to an angle made by three surfaces—floor of sinus, cerebral surface. and interfrontal septum (Figs. 4, 8 and 17). Toward this angle is situated the ostium. The floor in the vicinity of the ostium is made up of thin bone which forms the walls of some of the anterior ethmoid cells. External to the ostium are the cells, completed by the lachrymal bone. Posteriorly one meets oftentimes an ethmoid cell protruding into the sinus called the frontal bulla, and behind this are other anterior and then the posterior ethmoid cells (Figs. 9, 10, 11, 15 and 18). In front of the ostium one is apt to meet an anterior cell and still further in front is the so-called nasal crest of frontal bone (Figs. 7 and 8), and still in front are the thick and dense upper ends of the nasal bone and nasal process of the superior maxilla (Figs. 12 and 13). Internal to the ostium and below it are thin lamellæ of bone subject to some immaterial variation, according to whether the ostium leads to the infundibulum or still further internal, so as to open under the forward projection of the middle turbinate bone (Figs. 8 and 15). In all instances the frontal sinus can be said to open into the nasal cavity through the anterior upper portion of the ethmoid bone (Figs. 9, 15 and 18).

Hence the ostium is surrounded on all sides by thin bone which may be fractured with comparative ease and thus a larger opening made. If this thin bone is broken away, and this is usually what is accomplished by the majority of operators, what seems to be a reasonably large opening to the sinus is obtained. This may suffice for the cure of many cases, but many failures follow because the opening becomes obstructed later.

If the under surface of a disarticulated frontal bone be observed (Fig. 7), the opening into the sinus will be found to correspond to the enlarged opening just described by breaking the walls of anterior ethmoid cells. It is commonly stated that this is the full extent of enlargement that the anatomy will allow, although some include the thin portion of the nasal crest of the frontal bone in this removal. Nevertheless, an opening in many instances nearly as large again may be obtained by removing a portion of the frontal bone which articulates with the nasal bone and nasal portion of the maxilla, together with the adjacent thick portion of these two bones (Figs. 8 and 13). This will be considered further later on. Internal and posterior to the ostium is a dangerous region which, as a rule, should be carefully avoided because of the risk of breaking into the cranial cavity (Figs. 9 and 17). The ostium is about on a level with the cribriform plate and the slit for the nasal nerve is internal and rather close to it, hence the great importance of the early introduction of a probe through the ostium which should be left there as a guide during the early part of the operation.

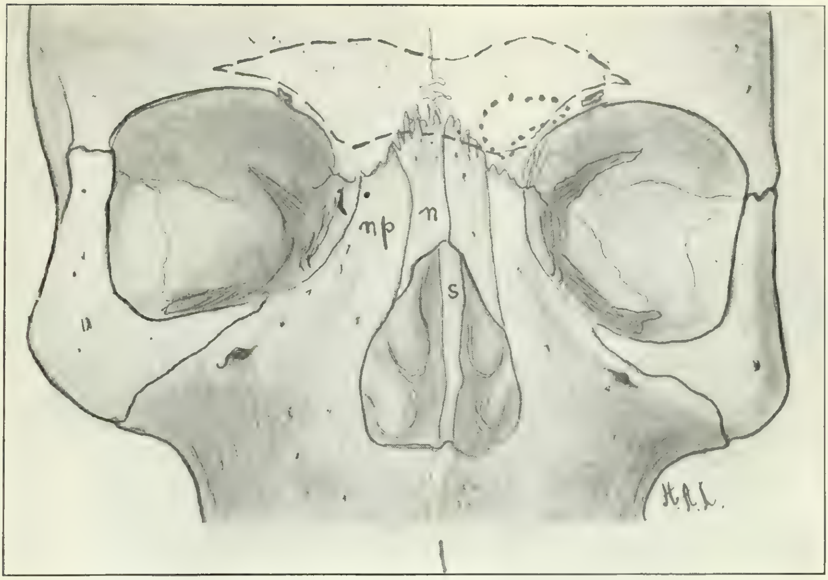
If a frontal bone be disarticulated, the following features will be observed in the region of the floor of the sinus around the bony opening, now comparatively large because the ethmoid cells are removed (Fig. 7). Externally is seen the line of articulation with the lachrymal bone and posteriorly the ethmoid cells. Posteriorly and internally is found the front end of the cribriform plate (Fig. 8), in front of which is a comparatively thin horizontal portion of the frontal bone called the nasal crest. This forms the inner boundary of the ostium. In front of the ostium, extending forward and toward the median line, is a dense and thick portion of bone of considerable area where the nasal process and the nasal bones articulate (Figs. 3, 4, 5, 8 and 13). This is a portion of the floor of the sinus which is not fully made use of in sinus operations.

In the median line, still a part of the floor, particularly if we consider the two sinuses together, we observe the thickened portion of the frontal bone where the perpendicular plate of the ethmoid bone articulates and, in front of this, the spine of the frontal bone (Figs. 5 and 14). In Figs. 3 and 4 we note the extreme upward and forward prolongation of the middle turbinate bone, external to which are the infundibulum and ethmoid cells, subject to comparatively immaterial individual variations as to ostia and cells. Internal to this lamella of the turbinate is the extreme anterior end of the roof of the nasal fossa formed in part behind by the cribriform plate (Fig. 8).

If, on the other hand, we look down upon the section after the frontal bone has been removed (Figs. 9 and 10), we observe again the structures around the bony opening from the sinus. The lachrymal bone and groove for the lachrymal sac are to be seen externally and behind are the ethmoid cells and cribriform plate; internally is the perpendicular plate and in front are the thick upper extremities of the nasal bones and the nasal processes of the superior maxillæ. Hence these two views (Figs. 9 and 10) demonstrate why a probe is left in the ostium during the early stages of the operation to serve as a guide to enable us to avoid destruction of bone posterior and internal to the ostium. These views indicate also the bone which may be removed in front and external to it.

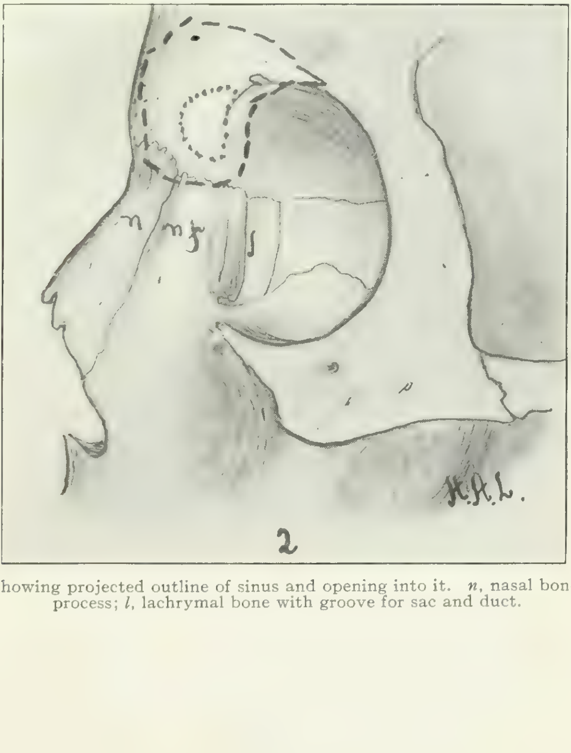
The distance between the front end of the cribriform plate and the upper ends of the nasal bones (Figs. 7, 8, 10, 17 and 21) is also subject to variation, and the knowledge of this distance before operation is of great importance. This can be determined by X-ray examination (Figs. 21–26). A lateral view of this region will add to an understanding of its topography (Figs. 4, 5, 10 and 21–26). Near the median line (Figs. 4 and 5) the thinner portion of the sinus floor shows posteriorly, and in front it becomes very thick and dense, made up

FIG. 1.



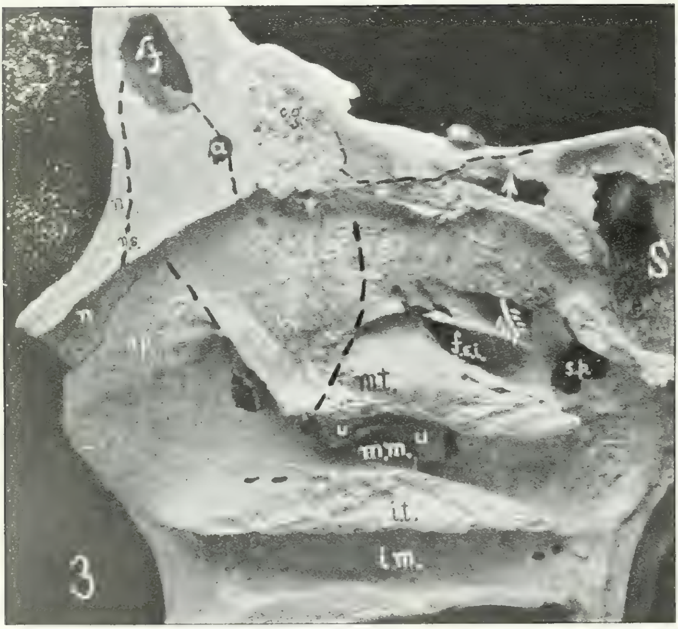
Front view skull. Projected outline of frontal sinus and opening into it. *n*, nasal bone; *np*, nasal process of superior maxilla; *s*, septum of nose; *l*, lachrymal bone.

FIG. 2.



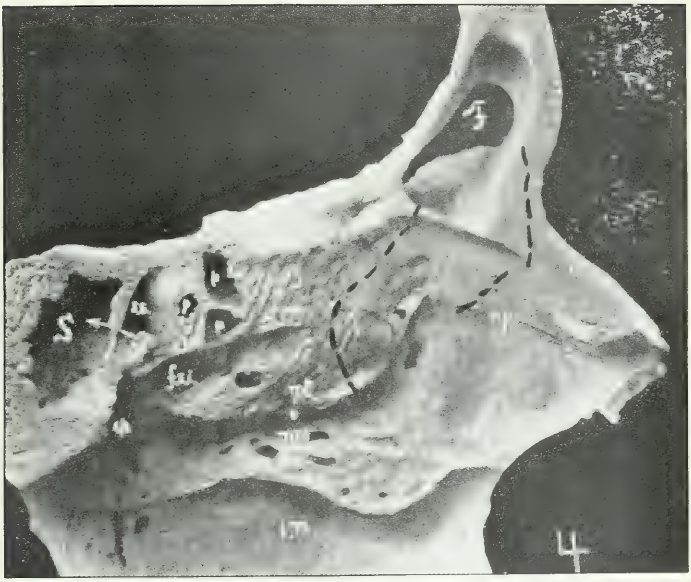
Side view showing projected outline of sinus and opening into it. *n*, nasal bone; *np*, nasal process; *l*, lachrymal bone with groove for sac and duct.

Fig. 3.



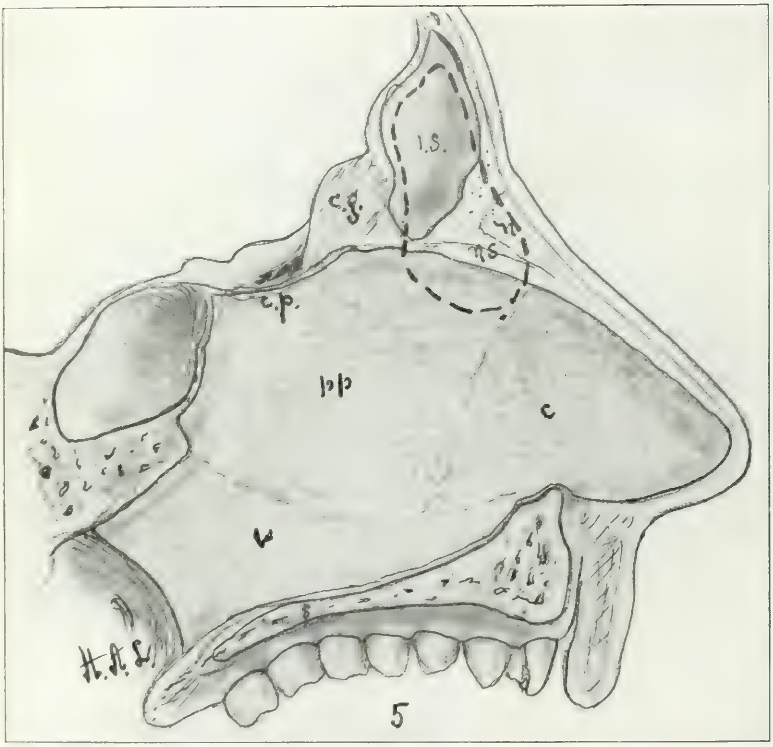
Outer bony wall of right nasal fossa. *F*, frontal sinus; *S*, sphenoidal sinus; *s.p.*, sphenopalatine foramen; *f.e.i.*, inferior ethmoidal fissure, arrow enters a posterior ethmoid cell from a middle ethmoid fissure; *a*, an anterior ethmoid cell which makes a frontal bulla; *n*, nasal bone; *n.s.*, nasal spine of frontal bone; *np*, nasal process of superior maxilla; *m.t.*, middle turbinate bone; *m.m.*, middle meatus; *u*, uncinate process; *i.t.*, inferior turbinate; *i.m.*, inferior meatus. Dotted line shows the portion of bone to be removed.

Fig. 4.



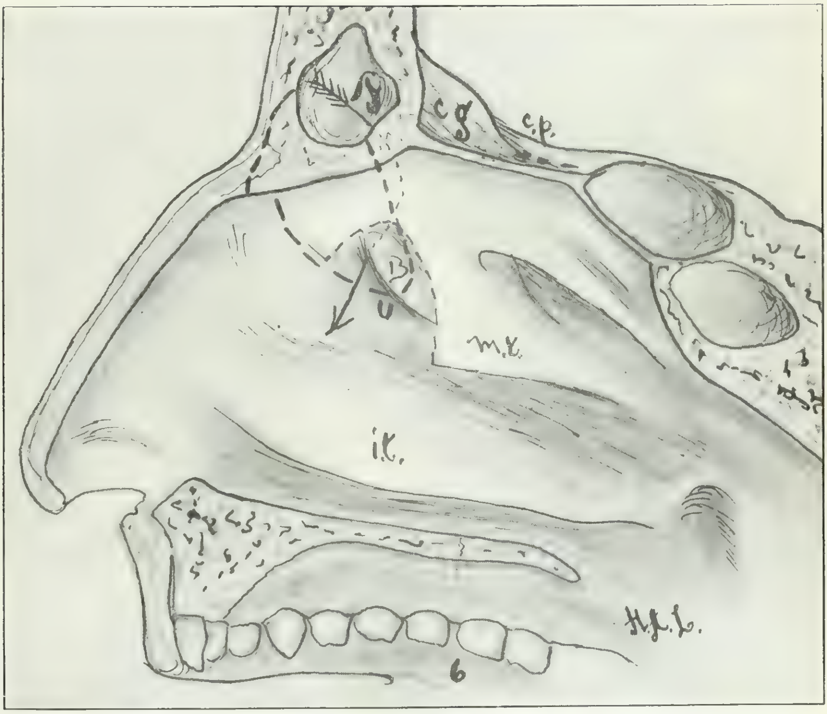
Outer bony wall of left nasal fossa. *F*, frontal sinus; *S*, sphenoidal sinus into which an arrow points passing through the ostium sphenoidale; *n*, nasal bone; *np*, nasal process of superior maxilla; *p,p*, broken posterior ethmoid cells; *s.t.*, superior turbinate; *f.e.i* , fissura ethmoidalis inferior; *s.p.*, sphenopalatine foramen; *m.t.*, middle turbinate; *u*, uncinate process; *mm*, middle meatus; *i.m.*, inferior meatus; *i.t.*, inferior turbinate. Dotted line shows the portion of bone to be removed.

FIG. 5.



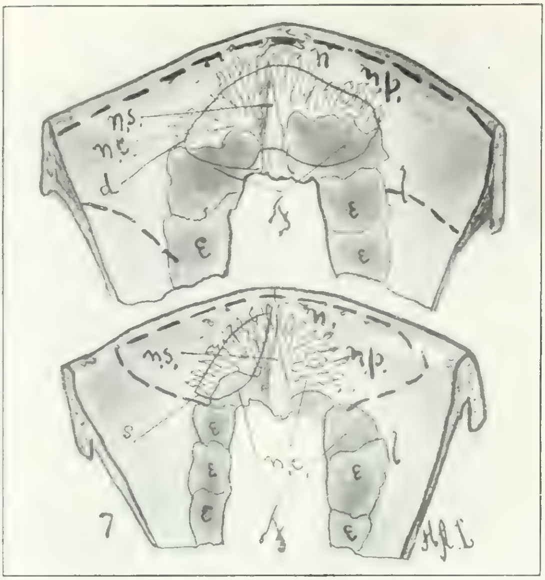
Shows interfrontal and nasal septum. *n*, nasal bone; *ns*, nasal spine of frontal bone; *c.g.*, crista galli; *c.p.*, cribriform plate; *pp*, perpendicular plate; *v*, vomer; *c*, triangular cartilage. Dotted line shows the portion to be removed in operations on both sinuses.

FIG. 6.



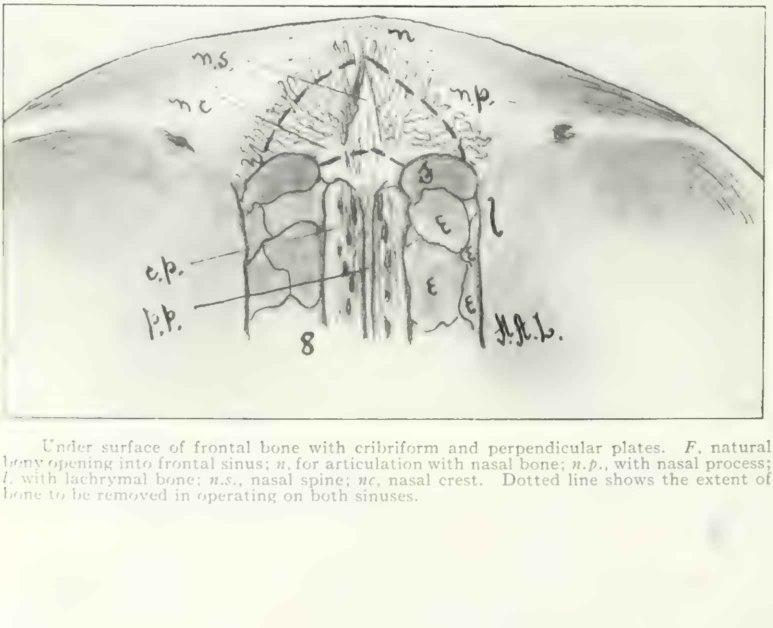
F, frontal sinus; arrow passes through its ostium coming out through the infundibulum at the hiatus semilunaris; *cg*, crista galli; *c.p.*, cribriform plate; *m.t.*, middle turbinate; *i.t.*, inferior turbinate; *B*, ethmoid bulla; *u*, unciform process. Dotted line shows the bone to be removed whether for single or double sinus.

Fig. 7.



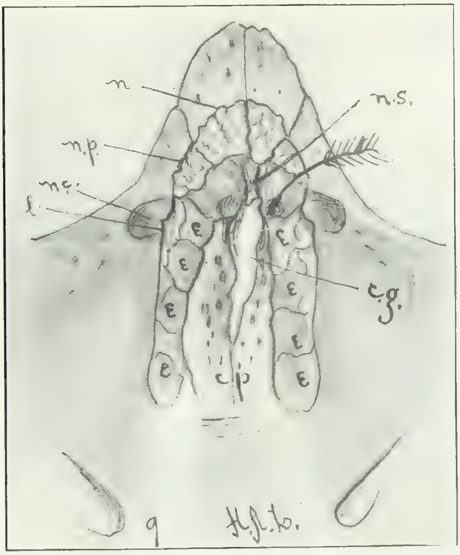
Portions of frontal bones, under surface. *F*, opening to frontal sinus; *n*, for articulation with nasal bone; *n.p.*, with nasal process; *l*, with lachrymal bone; *e*, for completion of ethmoid cells; *n.s.*, nasal spine; *n.c.*, nasal crest; *s*, thick bone to be removed for a single sinus; *d*, for a double sinus.

Fig. 8.



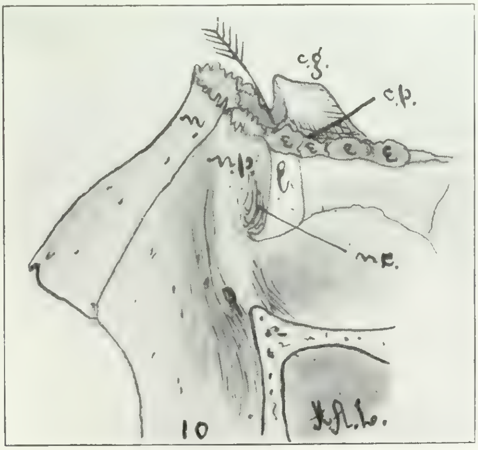
Under surface of frontal bone with cribriform and perpendicular plates. *F*, natural bony opening into frontal sinus; *n*, for articulation with nasal bone; *n.p.*, with nasal process; *l*, with lachrymal bone; *n.s.*, nasal spine; *nc*, nasal crest. Dotted line shows the extent of bone to be removed in operating on both sinuses.

FIG. 9.



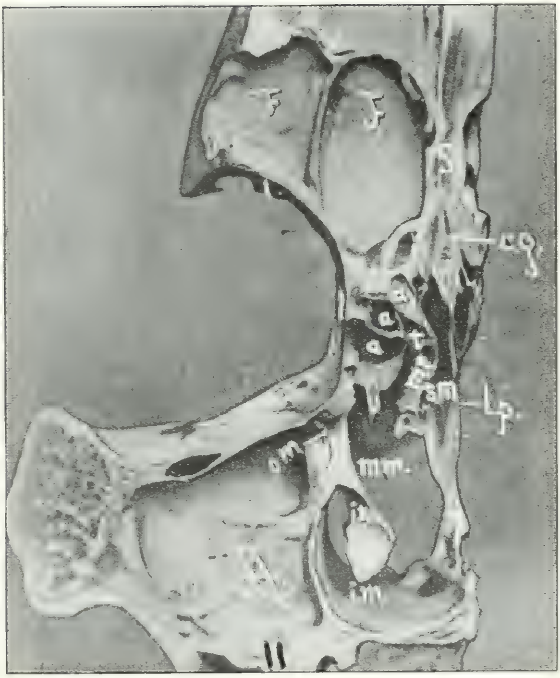
Showing structures under frontal bone. *n*, nasal bone; *n.p.*, nasal process; *l*, lachryma bone; *n.c.*, nasal canal; *c.g.*, crista galli; *c.p.*, cribriform plate; *e*, ethmoid cells. Arrow through ostium of right frontal sinus.

FIG. 10.



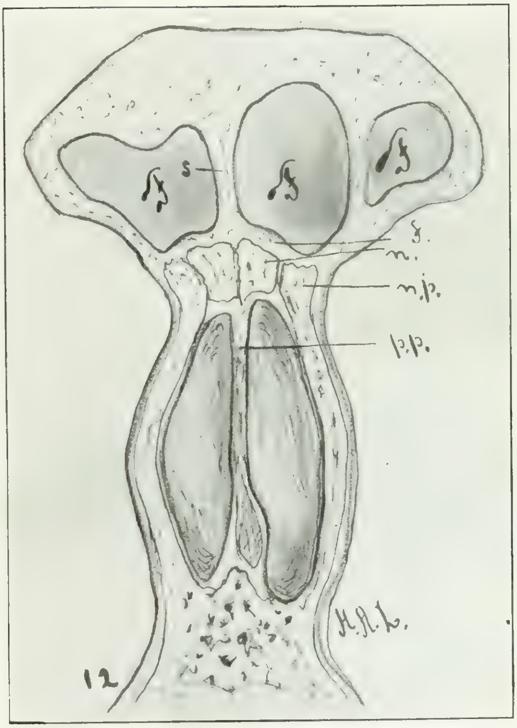
Side view of Fig. 9. Same lettering.

FIG. 11.



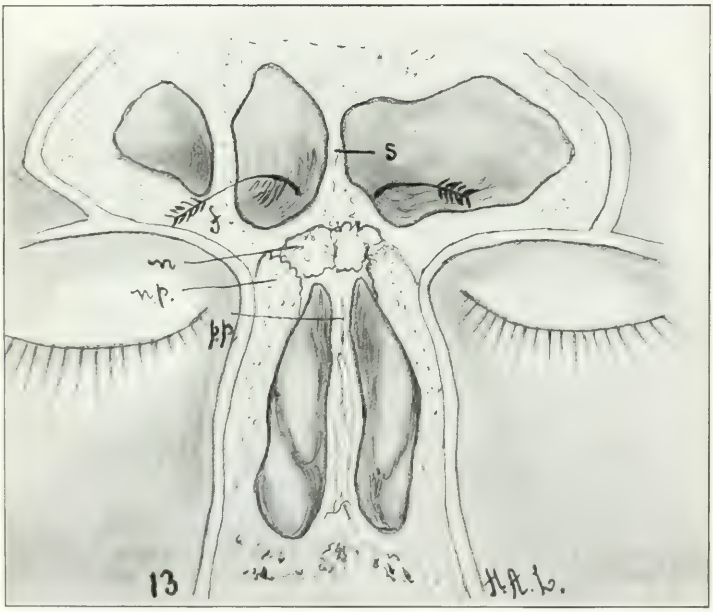
Bone. Coronal section through ostium maxillare; anterior half. Posterior wall of frontal sinus removed. *F*, an anterior wall of frontal sinus showing a vertical septum; *S*, septum between the frontal sinuses; *i.t.*, inferior turbinate; *m.t.*, middle turbinate; *o.m.*, ostium maxillare; *u*, uncinate process; *l*, os lachrymale; *t*, turbinate fossa; *a,a,a*, anterior ethmoidal cells internal to lachrymal bone; *A*, antrum of Highmore; *l.p.*, lamina perpendicularis; *c.g.*, crista galli; *i.m.*, inferior meatus; *m.m.*, middle meatus; *s.m.*, superior meatus; *i*, inferior wall of frontal sinus (orbital portion). Dotted line corresponds to nasal portion.

FIG. 12.



Sagittal section at base of nasal bones, looking forward. *F*, frontal sinuses with a partition in the right side; *f*, frontal bone; *n*, nasal bone; *n.p.*, nasal process; *p.p.*, perpendicular plate of ethmoid; *s*, interfrontal septum.

Fig. 13.



Same as Fig. 12, looking backward, same lettering. Arrows directed toward posterior angles to frontal ostia.

FIG. 14.

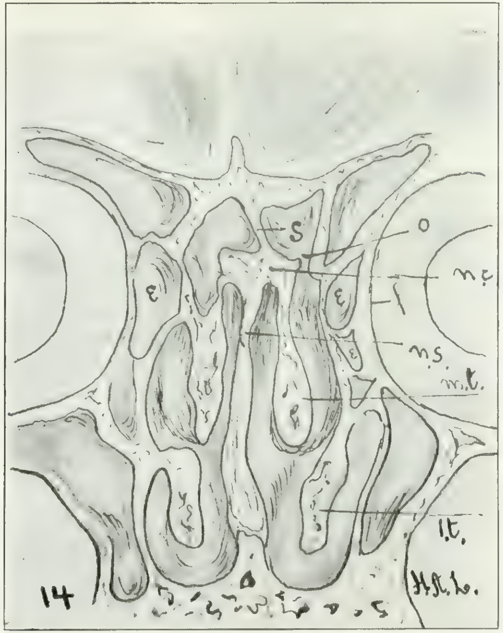
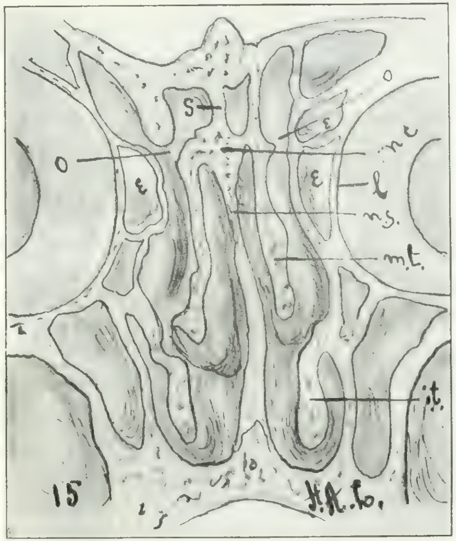
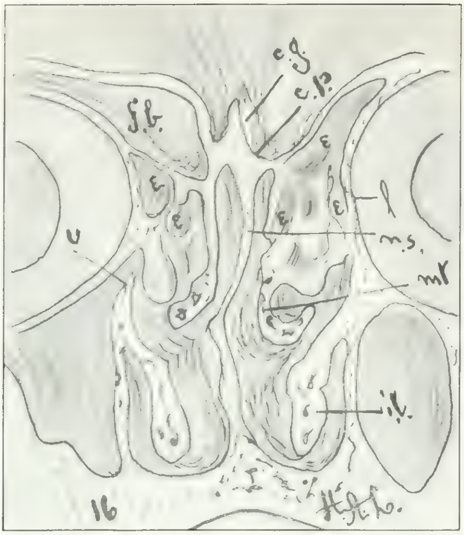


FIG. 15.



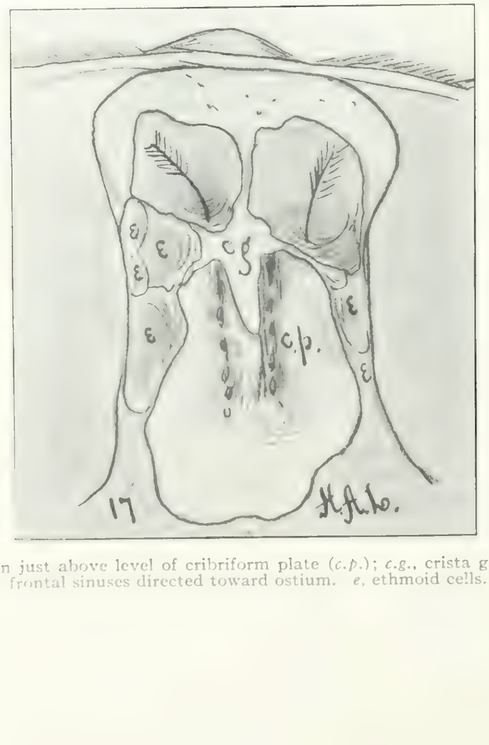
Section of same specimen through region of ostia of frontal sinus first looking forward and then backward, same lettering. *S*, interfrontal septum; *n.s.*, nasal septum; *o*, ostium frontale; *n.c.*, nasal crest; *m.t.*, middle turbinate; *i.t.*, inferior turbinate; *E*, ethmoid cells; *l*, lachrymal bone.

FIG. 16.



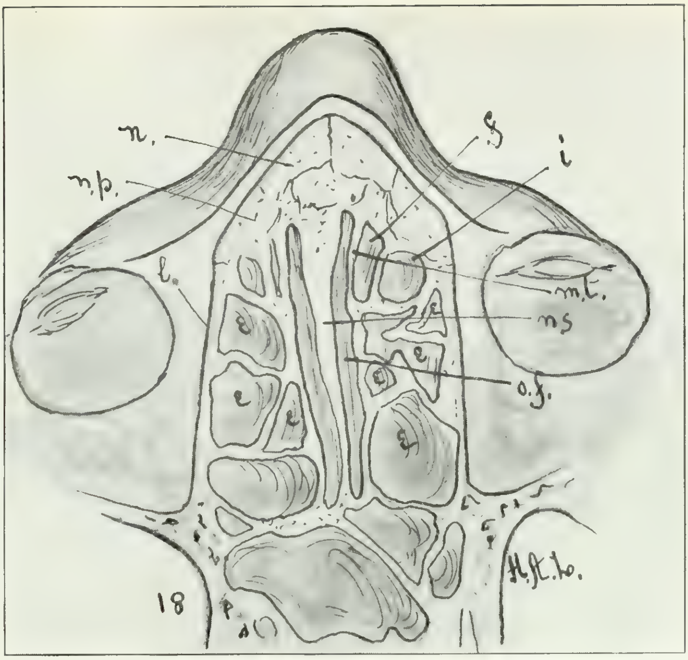
Same specimen, section behind crista galli and ostia of frontal sinus, looking forward. *c.g.*, crista galli; *c.p.*, cribriform plate; *n.s.*, nasal septum; *f.b.*, frontal bulla; *e*, ethmoid cells; *l*, lachrymal bone; *mt*, middle turbinate; *i.t.*, lower turbinate; *u*, unciform process.

FIG. 17.



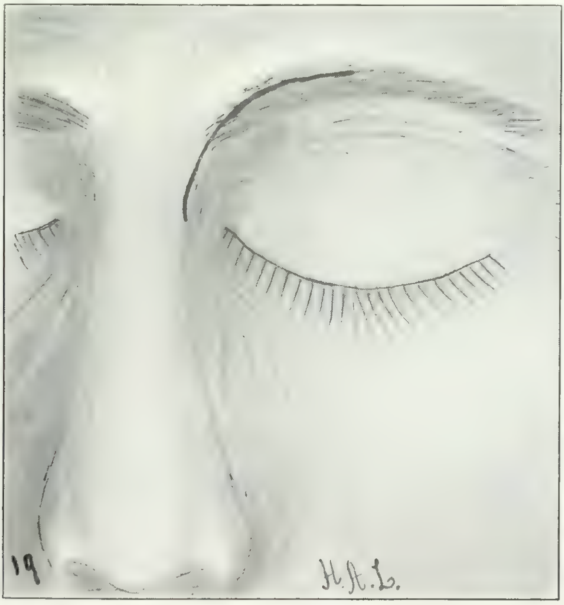
Horizontal section just above level of cribriform plate (*c.p.*); *c.g.*, crista galli. Arrows in frontal sinuses directed toward ostium. *e*, ethmoid cells.

FIG. 18.



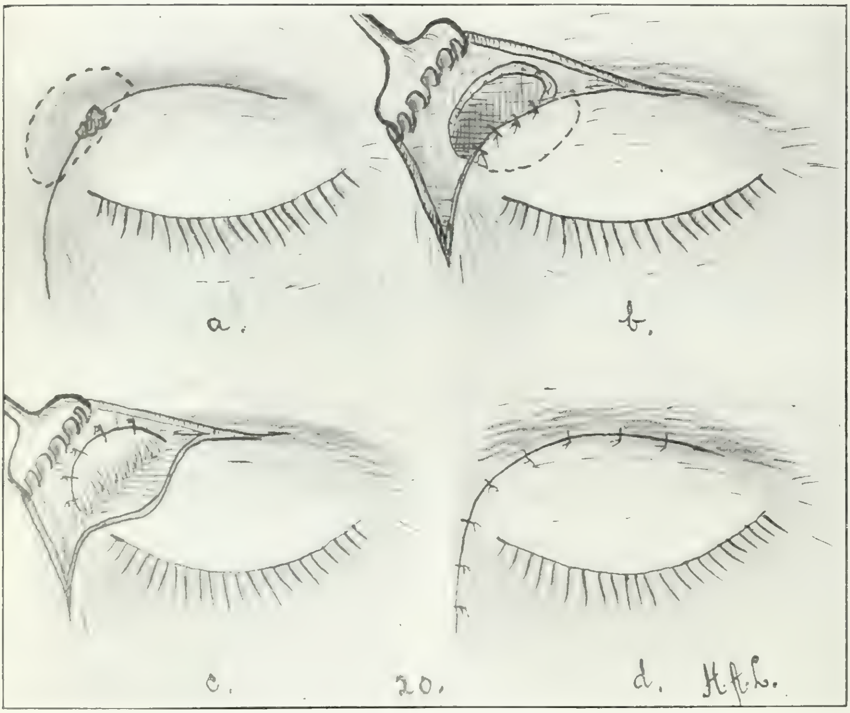
Horizontal section of same specimen just below level of cribriform plate. *n*, nasal bone; *n.p.*, nasal process; *l*, lachrymal bone; *n.s.*, nasal septum; *m.t.*, upward continuation of middle turbinate; *o.f.*, olfactory fissure; *f*, leading to frontal sinus; *i*, infundibulum; *e*, ethmoid cells.

FIG. 19.



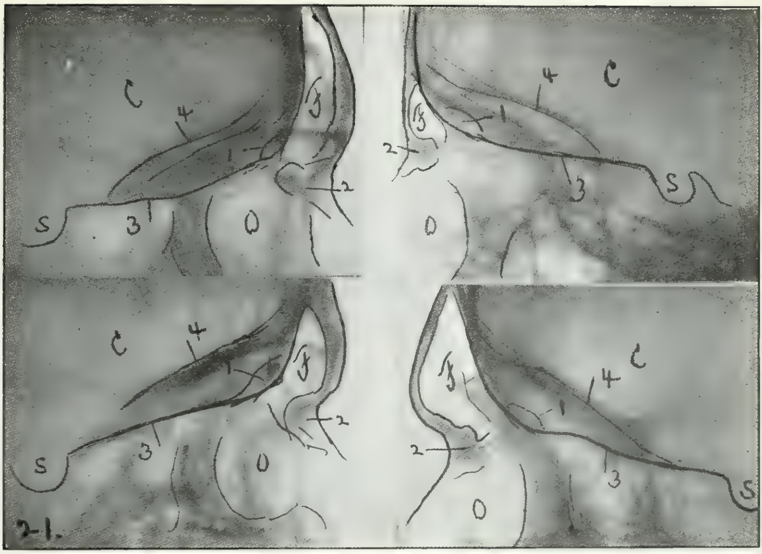
Showing skin incision.

FIG. 20.



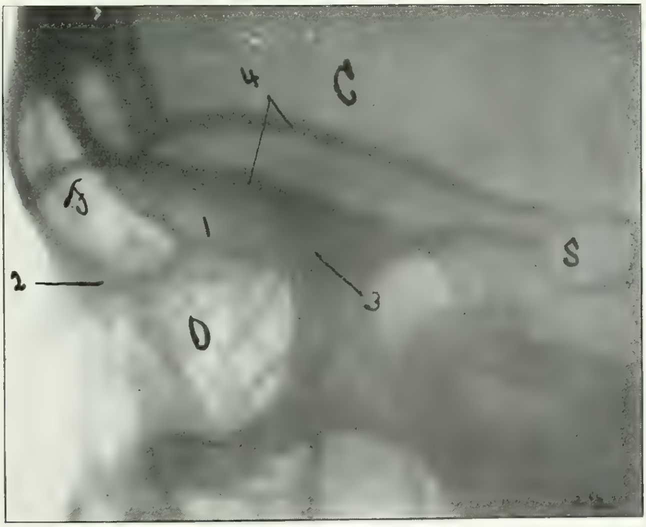
Epidermization of frontal sinus. *a.*, shows scar, fistula and opening in bone; *b.*, bone exposed, edge of lid sutured, outline of skin flap; *c.*, flap sutured in place over opening to sinus; *d.*, wound closed.

FIG. 21.



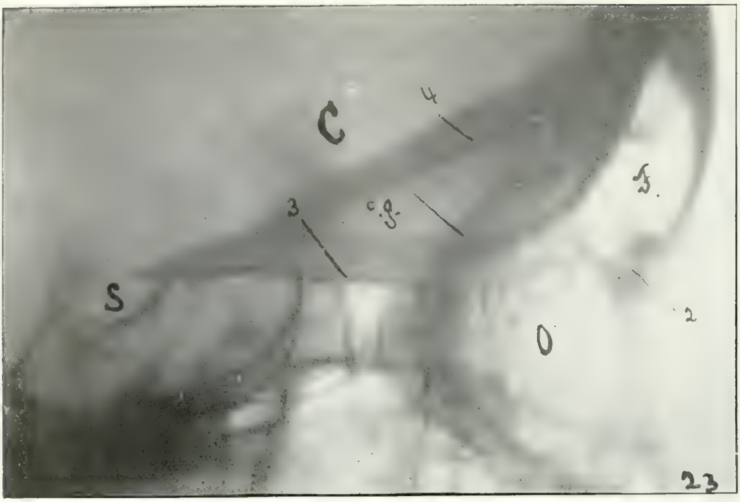
Tracings over lateral skiagraphs to show the dense bone at floor of frontal sinus in front and the relative distance between the base of the nose and the crista galli, most of which can be utilized. 1, crista galli; 2, dense bone made up of nasal and frontal bones and nasal process of superior maxilla; 3, cribriform plate continuing forward in the general curve of the cranial cavity; 4, roof of orbit; *F*, frontal sinus; *O*, orbit; *C*, cranial cavity; *S*, sella turcica.

FIG. 22.



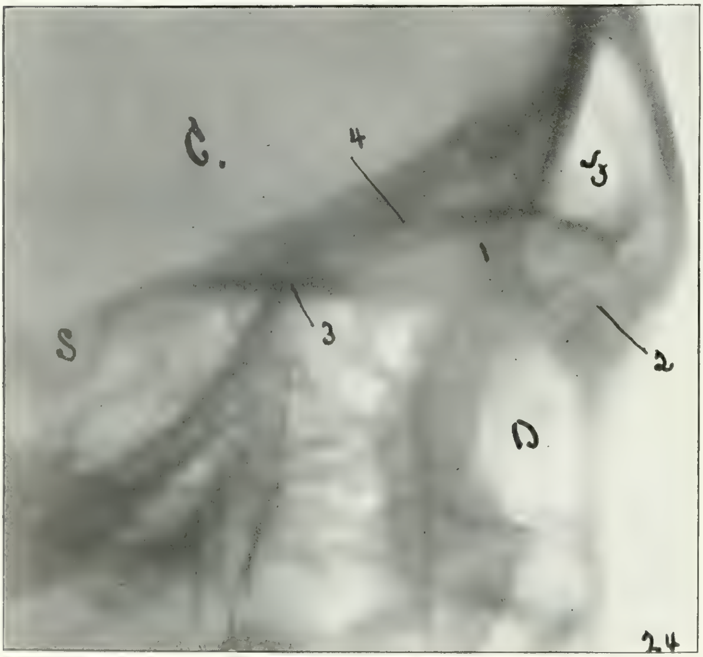
Lateral skiagraph. Lettering as in Fig. 21.

Fig. 23.



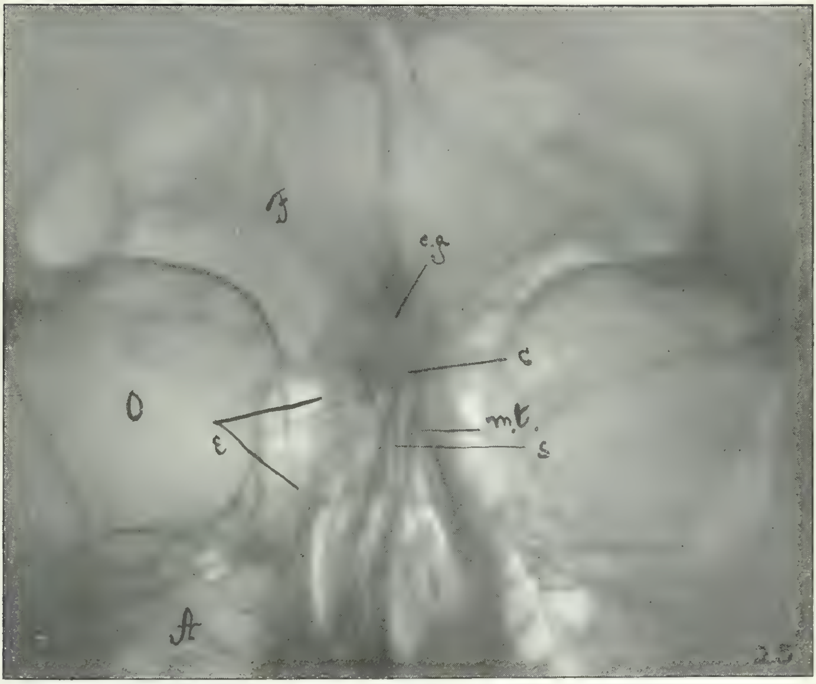
Lateral skiagraph. Lettering as in Fig. 21.

Fig. 24.



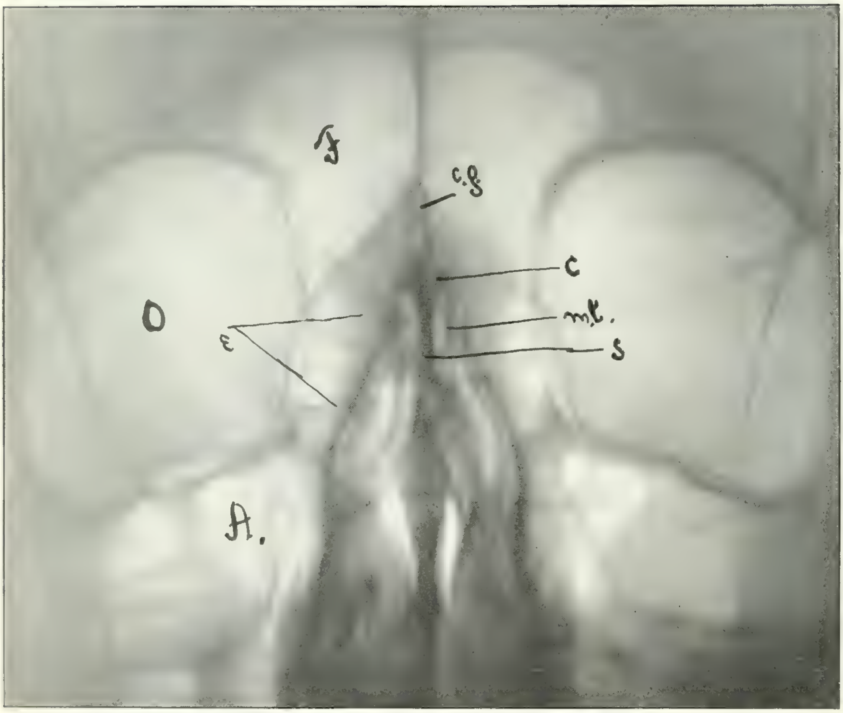
Lateral skiagraph. Lettering as in Fig. 21.

FIG. 25.



Anteroposterior skiagraph. *F*, frontal sinus; *O*, orbit; *A*, antrum; *c.g.*, crista galli; *c.*, cribriform plate; *S*, septum of nose; *m.t.*, upward projection of middle turbinate; *E*, ethmoid cells.

FIG. 26.



Anteroposterior skiagraph. *F*, frontal sinus; *O*, orbit; *A*, antrum; *c.g.*, crista galli; *c*. cribriform plate; *S*, septum of nose; *m.t.*, upward projection of middle turbinate; *E*, ethmoid cells.

of the perpendicular ethmoid plate, nasal crest, nasal spine, and upper end of nasal bone. A little more lateral the floor has become much thinner posteriorly, but in front the nasal crest and upper end of nasal process of superior maxilla are still very thick. Sagittal sections (Figs. 3–6 and 21–26) demonstrate this very thick bony ring in the anterior portion of the sinus floor.

The arrangement of ethmoid cells below the sinus will not be considered here in detail because they have been considered so frequently in other publications. Those having particular bearing are in immediate relation with the lachrymal bone, the inner aspect of the nasal process, and the so-called agger nasi cell, often present at the extreme end of the middle turbinate.

The *internal* wall of the frontal sinus is the interfrontal septum and its extent and position and the existence of frontal septa should be determined by X-ray examination. The septum is practically in the median line, but of course is subject to some variation. Its central portion is thin and its circumference thicker, particularly below, where it continues as the septum of the nose (Figs. 5, 11 and 13). At its lower, posterior angle is the crista galli, which is separated by the posterior wall of the sinus. Occasionally the sinus itself projects into the crista galli, a fact which should be borne in mind. However, this angle is behind the guiding probe and should never be interfered with. The front corner of the cribriform plate may project well into this angle at the base of the crista galli (Figs. 9 and 17).

Hence, to summarize the practical points brought out by the above:

The region of the ostium of the sinus is surrounded by thin bone.

The whole nasal floor of the sinus represents the maximum area for the acquiring of drainage.

The area posterior and internal to the ostium is comparatively small, and it is too dangerous a region for interference, although, with great care, a protruding ethmoid cell may be destroyed.

The area in front and external to the ostium is by far the larger and is comparatively thick and dense. All of this may be removed with comparative safety by means of special instruments.

The partition between the sinuses and its continuation into the nasal septum (perpendicular ethmoid plate) may also be removed without risk and thus extra space be gained.

X-ray examination in two planes must be made before operation, in order to determine certain relations which are variable.

A clear understanding of the lymphatic and venous channels of drainage is necessary in order to determine subsequently the extent and location of infection. There is some drainage into the superior longitudinal sinus and also into the lymph-vessels of the cranial cavity.

Röntgenologic Examination.—The Röntgen portrayal of the conditions in and about the sinus is of great importance, partly as an aid to diagnosis, but particularly as a means of determining the site and dimensions of the sinus.

Slight pathologic changes in the region could not be detected, but extensive alterations in the density would be evident. Hence, as an aid to diagnosis, the skiagraph may be of some value, but other signs are of greater importance. I believe the chief value of X-ray examination is the portrayal of the anatomy of the region, for thus we are enabled to picture anatomic features of paramount importance. The site of the sinus can be established so that the exploratory opening can be made with the assurance of entering it. The lateral views will determine the amount of space between the front end of the cribriform plate and the base of the nose, a factor of great importance in the technic to be described.

Two views should be made—an anteroposterior and a lateral one. More than ordinary precision is required, both as to symmetry and point of focus. Dr. Percy Brown has devised an apparatus for fixing the head and obtaining most satisfactory skiagraphs in these difficult cases, and to him I am also indebted for the illustrative prints ("The Diagnostic Evidence Obtained from X-rays from the Lateral Aspect of the Skull." *Boston Medical and Surgical Journal,* June 12, 1913). Anteroposterior views give us the height of the sinus, the level of the cribriform plate, and the width of the space between the lachrymal bones. The lateral views show all the anteroposterior dimensions, particularly the available space for enlarging the opening, and the position of the crista galli and the front end of the cribriform plate. The base line of the cranial cavity can always be demonstrated.

Transillumination is not of much diagnostic or operative value, and reveals nothing that cannot be discovered by other means. A sinus filled with pus or hypertrophied tissue or a small sinus might be suspected as a result of such examination. No operative guides can be made out. Hence contributory evidence may be obtained.

Technic of Operation.—Preliminary to any external operation upon the sinus, effort to cure by intranasal methods along safe lines should have been thoroughly tried. This means that the front of the middle turbinate has been removed and many anterior ethmoid cells broken through. X-ray findings should have been carefully studied. Application of a four per cent. solution of cocaine and adrenalin (1–2000) to the extreme upper front portion of the nasal cavity will lessen materially the amount of hemorrhage. The usual bone cutting instruments and slender curettes should be selected, but the essential portion of the operation is performed solely by means of burr drills of selected sizes mounted on curved and straight shanks. The burr drills devised by Tilley and Ballinger for antrum operations serve our purpose well, particularly those with the curved shank.

The patient is placed in a sitting posture and the head kept horizontal most of the time. There is less shock when the patient is placed semirecumbent, and this position may be selected, but greater caution is needed to keep in mind the anatomic relations and hemorrhage may be more troublesome.

In order to avoid the annoyance of blood escaping into the pharynx, the posterior nares may be plugged or, better still.

narrow strips of gauze may be introduced *via* the anterior nares, leaving the front half of the nasal fossa free for operation. Ether should be administered through a tube entering the mouth to the pharynx, so as to avoid any delays or annoyance from this source.

The incision is the middle portion of the one used in the Killian operation and, in fact, the one adopted for most of the frontal sinus operations. It extends from about the centre of the unshaven eyebrow inward and then downward a short distance on the outer side of the nose. The supra-orbital nerve may be spared in some cases (Fig. 19). An area of bone at the base of the nasal process and nasal bone and above is exposed and denuded of periosteum. The sinus should be entered just above the base of the nasal process (Fig. 2), easily accomplished by means of small chisels and gouges, and enlarged by rongeur forceps. The sinus is then explored by means of a small probe. The ostium will be found situated toward the posterior angle. Pass the probe down into the nose and out the anterior nares. The upper end should protrude through the wound and be bent so that the probe will stay in place of itself. Pass small curettes from above down through the floor of the sinus, always in front of and external to the probe at the ostium. Thus, the thin walls of anterior cells are broken up until the ostium becomes considerably enlarged. During these manipulations or earlier the walls of the sinus should be freed from excessive granulation tissue or polyps, if such be present. If the mucous membrane of the sinus is not materially hypertrophied, it is probably better not to curette it, for thus we obtain a better chance for resolution after the lower obstruction is removed. However, if there is much hypertrophy, ulceration, etc., the thickened portion should be curetted, but the periosteum of the lining of the sinus should not be removed. If distal portions of the sinus are already practically obliterated by dense scar tissue, do not disturb it.

The object of this minimum of curetting is to impair as little as possible the nutrition of the bony walls of the sinus and thus avoid subsequent necrosis. After a short time the sinus hemorrhage will be practically arrested and the vicinity of the ostium can be inspected. Almost all of the subsequent work is performed by the burr drills, introduced chiefly through the nose so that the burr is almost always in sight. These instruments are to be used just as a dentist reams out the carious portion of a tooth. No other instrument can be used for this purpose, because the part to be removed is otherwise inaccessible, and the use of chisels and rongeurs would be dangerous and inexact. The burr gnaws away the bone with precision and safety. At first the smaller burrs are introduced through the anterior nares to the region of the guiding probe. First, the nasal crest is removed and the process continued anteriorly toward the nasal bone and nasal process at about their upper suture line. As the opening becomes larger the larger burrs can be used. By this means this portion of the nasal bone and the nasal process of the maxilla, together with the adjacent part of the frontal bone becomes very thin and there remains only a bony shell around the circumference of the enlarged ostium. It is surprising how large an opening can thus be obtained. By means of the burr drill and a curette the ethmoid cells, which may be present at the upper end of the infundibulum and opposite the lachrymal bone, and the agger nasi cell should be destroyed. While working opposite the lachrymal bone, the finger should be pressed gently in the inner canthus to serve as a guide and for protection. The lachrymal bone and the external surfaces of the ends of the nasal bone and nasal process should not be broken through, for these thin shells will serve to keep the region of the ostium from sinking in. This I believe to be the usual cause for failure in the modern radical operation where this portion of the wall has been destroyed.

Recent cases operated upon have demonstrated the wisdom of making use of the combined nasal floor of both sinuses, even though only one sinus is pathologic, in the manner described below for operation in cases in which both sinuses are involved. The mucous membrane of the healthy sinus does not become diseased and the proximity of healthy mucous membrane favors early epidermization. Furthermore, the single opening in the facial wall gives ample opportunity for the complete operation, because we do not care to reach the distal portions of the normal sinus. A large part of the interfrontal septum is removed and, if desired, we could readily probe and curette the healthy sinus.

If both sinuses are involved, the opportunity for a large opening is most excellent. The X-ray findings have already shown the topography of the sinus and, in particular, the distance between the crista galli region and the anterior contour of the sinus and also the extent of the interfrontal septum. The opposite sinus may be opened and its ostium enlarged in the manner described above. Then this septum is perforated in its thin, central portion and its anterior and lower portion enlarged with the burr, gradually approaching the floor of the sinus. We are now at the base of the bridge of the nose, behind which is much dense bone in the vicinity of the median line where the septum of the sinuses and that of the nose meet. This can be removed readily with the burr in view, leaving a thin protecting shell of bone in front. The portion of the septum of nose just below the sinuses should be removed also with the burr. This is made up of the perpendicular plate of the ethmoid and is to be removed for a depth of nearly one inch (Figs. 5 and 13). As in any sinus operation, the posterior angle of the sinus and the region of the front end of the cribriform plate should be avoided at all times. It is surprising to observe in the average sinus how much space for drainage can thus be obtained. From below a comparatively large instrument can be swept across from one sinus to the other and from either nostril into either sinus. The removal of this median partition adds so much more to the efficiency of the drainage that I believe it should be done even in cases where only one sinus is involved. It may, at first thought, seem an unwise step but I believe it will work for good and not harm in every instance. A sinus is opened frequently for exploration and generally without ill effect but, if any harm does follow, it is because of accumulated blood clot which cannot escape and which becomes infected. In these cases where the opposite side is opened, there is no chance for retention and the healthy mucous membrane does not become infected and pus is not retained. This is on the same principle that an antrum may act simply as a reservoir in frontal sinus suppuration and give no further trouble after the latter is cured. Furthermore, the chance for drainage is poor compared with that of the frontal sinus treated as above. Besides obtaining a very large opening, another advantage of connecting the sinuses is the fact that the mucous membrane of the healthy side allows epidermization in the vicinity of the new ostium on the diseased side. In skilled hands the whole operation can be accomplished through a single external opening, although a double opening is safer.

By the time the operation is completed the hemorrhage has practically ceased. With the head tipped forward, the external wound should be washed with a sterile solution and the skin incision closed. The tampons are to be removed from the nose and a compress bandage applied. The after-treatment is the same as in any case. Irrigation should be avoided for several days. As the intranasal areas begin to granulate around the ostium they should be kept clean and smooth by the usual methods. The whole sinus cavity is now particularly accessible for treatment.

The Closure of Fistulæ.—Fistulæ are the result of obstruction at the ostium and may arise spontaneously or after operation. If the ostium becomes occluded during the course of an acute inflammation and remains so, an empyema or practically an abscess results, which in turn will cause a perforation of one of the walls of the sinus. An external fistula results if the perforation takes place through the facial or orbital wall; this tends to last indefinitely until corrected by operation. Following operation, where an attempt has been made to enlarge the ostium, a fistula may develop in the line of incision. This may appear after a few days, weeks or months, and is due to the fact that the opening has become obstructed, partly by œdema and later by granulation tissue at the site of the ostium. These external fistulæ will remain closed only after a permanently patent ostium has been established by some means or other. It is fair to assume that this complication occurs in the obstinate cases which require more careful and radical treatment. Here again the operator must decide whether he will attempt to obliterate the sinus or establish a large ostium.

Epidermization of the Sinus.—During the operation upon one of the obstinate cases, where an external fistula had existed in each sinus for over a year, Dr. O. A. Lothrop suggested the possibility of epidermizing the frontal sinus as is sometimes done after mastoid operations. I do not know that this has ever been attempted in the frontal sinus, but I felt that if the vicinity of the ostium could be protected with epithelium it would lessen the chance of granulation obstruction and the flap would serve as an island whence epithelium would tend to spread in all directions over the remaining sinus wall, as after the manner of any skin graft. This case was particularly obstinate because the supporting wall of the upper part of the lachrymal bone and nasal process had been removed by previous operators.

The following technic was devised and carried out and the parts have remained closed, an interval of twenty months having since elapsed. Just how much spread of epithelium has taken place it is impossible to determine. The sinuses were large and at the present time there is no discharge and the patient considers himself cured.

The steps are as follows, as illustrated in Fig. 20: After the vicinity of the ostium has been enlarged to as great an extent as the anatomy will allow, as described above, the edge of the skin of the upper lid is sutured to the periosteum on the outer edge of the bony opening into the sinus with small catgut (Fig. 20, *b*) ; then an oval incision is made in the lid down to the muscle fibres, so as to form a flap about the size of the opening in the bone. The blood supply of the lid is excellent and the flap is very movable so that it turns readily without much cutting after division of the thin skin of the lid. The flap is now to be turned so as to cover the bony opening and is sutured to periosteum, preferably with fine chromicized catgut. Then the parts are washed carefully with a sterile solution and the remaining wound is closed. The lid is to be drawn across horizontally and it will be observed that there is very little tension and subsequent œdema, and that the motion of the lid is not interfered with. In the two instances where the sinus was grafted, the scar is scarcely perceptible in one and in the other the depression is moderate and is due to the previous extensive destruction of bone.

This paper is designed to present general principles and a technic for operation. A list of cases operated upon is not included, as thereby nothing would be added to what has already been said.

BLEPHAROPLASTY BY A PRE-GRAFTED FLAP.*

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In the late nineties while acting as surgeon to the Work House and Almshouse Hospitals I had several opportunities to see the end results of plastic operations performed for the relief of tissue defects resulting from excisions of epitheliomata of the eyelid. These were, in general terms, very bad, very unsightly, and very uncomfortable. The plastic flap in most of these cases was tightly stretched across the eye-ball and adherent to the conjunctiva, causing discomfort and distress and lamentable cosmetic appearances. It occurred to me then that in attempting to reconstruct the eyelid we ought to keep its functions in mind and try to reproduce them in any reconstruction work.

A proper eyelid is, of course, smooth, is lined with an epithelial layer, in this case representing the mucous membrane of the conjunctiva, and of course is free from the eyeball. It seemed to me, therefore, that any transplanted flap which was to replace a gap in the eyelid should have an epithelial lining. This epithelial lining could, of course, be supplied by applying a skin graft to the back or raw surfaces of a pedunculated flap and there is sufficient evidence that epidermis transplanted into mucous lined cavities assumes to a sufficient degree the characteristics of the mucous membrane.

I found that quite naturally the same idea had occurred to others; that is, after plastic flaps had been made, to fill the gap in the eyelid, a skin graft was put on the reverse side. Personally, I never had any opportunity to verify the results, good or bad, of this procedure, but I knew from general experience that skin grafting under these conditions gave no assurance of successful union. I determined, therefore, to devise a method which would allow the transplantation of a flap which already satisfied these conditions.

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* Read before the American Surgical Society, April 11, 1914.

My first case, Lena W., presented herself ten years ago and gave me the opportunity to carry out these theoretical requirements. In her case I deliberately chose to utilize the form of plastic advised by Dieffenbach, which I believed would assure me the best kind of flap with which to carry out the preliminary grafting, although the flap itself, having a pedicle lying vertically below the eyelid, possessed the disagreeable feature of drawing down the eyelid and the result was not any too satisfactory on account of the inherent defects of the flap, although the requirements, namely, a movable eyelid with the internal surface lined by epithelium and nonadherent to the conjunctiva, were obtained. In my second case I chose to make the flap recommended by Fricke but more nearly horizontal, and the result was so satisfactory that it is this operation that I describe and recommend.

We start out then with the idea that we shall outline the flap and prepare it by grafting its inner surface and only remove the lesion (epithelioma) and transplant the flap into the resulting cavity when the flap shall have been demonstrated to be properly prepared to take the place of the eyelid. A two-stage operation then becomes a necessity. The various steps of the operation are readily understood by a study of the accompanying illustrations. The preliminary operation might be done, if necessary, under local anæsthesia but I should prefer it to be under a general anæsthetic, as was done in both cases, so that the outlines of the flap should not be obscured by infiltration of cocaine or possibly the wound healing so jeopardized. The first step consists in making an incision through the whole thickness of the skin, starting at the external canthus and running somewhat obliquely upward for a suitable distance, according to the size of the flap required. In my two cases the lesion occupied the external half of the lower lid and a flap one and three-quarters inches was outlined. Fig. 1 shows the single incision through the skin, the dotted lines show the area of the proposed flap. By dissecting down through the preliminary incision a pouch is made corresponding to the size of the eventual flap and into this the skin graft can be tucked, just as one places a handkerchief in the pocket. A single skin graft of suitable proportions is cut and is introduced into the pouch, as shown in Fig. 2. It is a little larger in its vertical diameter than is necessary, allowing the top portion to be turned over on the raw edge of the flap. That completes the first stage of the operation. A protective dressing is applied and the graft is allowed to heal in place and the transplantation is not made until the healing is an accomplished fact and no raw surface exists. That would ordinarily take about 10 days.

At the second operation the epithelioma is excised by removing the outer half of the eyelid by a quadrangular incision, the outer vertical leg of which just impinges on the skin out of which the pre-grafted flap is composed (Fig. 3). In Fig. 4 is shown a horizontal incision parallel to the first original incision, thus freeing the flap and allowing it to be slid over into the gap left by the excision of the epithelioma. Fig. 5 shows the flap sutured into place and the operation completed. The healing takes place readily in less than a week. The after-results have been satisfactory, as can be seen by the photographs of these patients. While the result in patient one is not quite satisfactory it is because the poor type of flap was used, but even then the advantages of the pre-grafted flap are obvious in that there is a free palpebral margin lined with a perfectly satisfactory substitute for mucous membrane which it now closely resembles. The preliminary operation allows for the occurrence of a normal shrinking of the flap and in making these flaps it is only necessary to cut them of the exact size necessary to fill the gap. This fact I learned by experience in these two cases where in each instance following the general principles of plastic surgery, the flaps were made over-generous with the expectation that they would subsequently shrink. This shrinkage did not occur and in both cases we have an over-generous palpebral opening. Ten years in Case 1 and seven years in Case 2 have elapsed since these operations, and

FIG. 1.

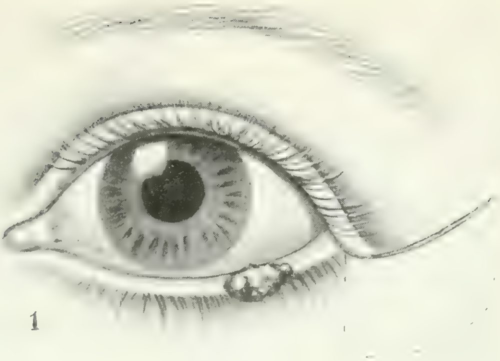


FIG. 2.

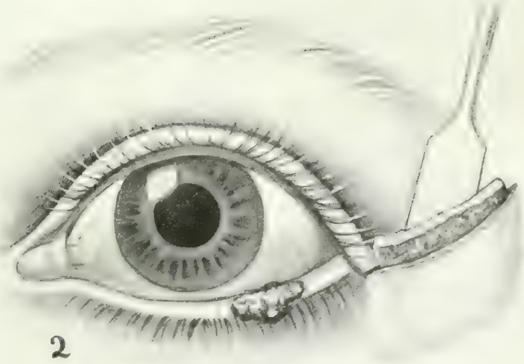


FIG. 3.

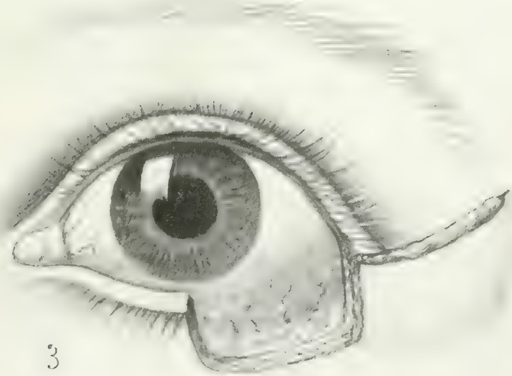


Fig. 4.

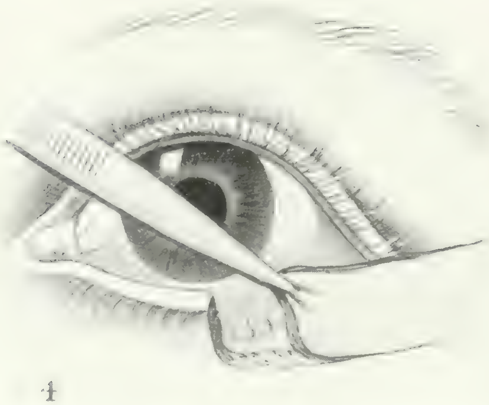


Fig. 5.

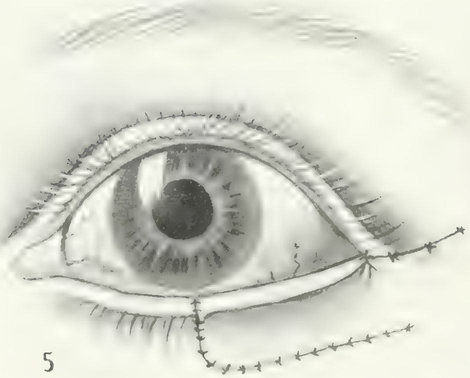
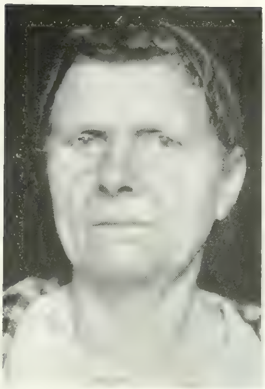
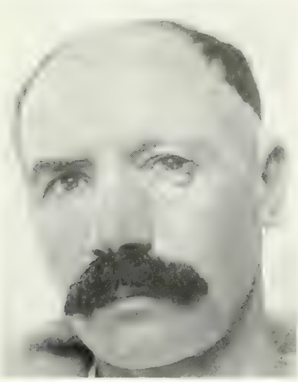


Fig. 6.



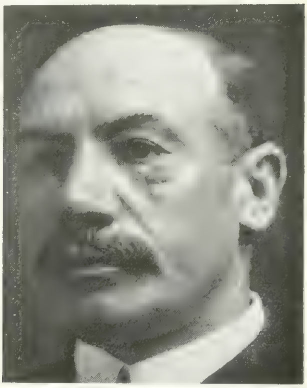
Case I. Ten years after operation

Fig. 7.



Case II. Before operation.

Fig. 8.



Case II. Seven years after operation.

in all that time the flaps have not shrunk or altered in any way.

Since the advent of various therapeutic measures destined to compete with surgical procedures in the removal of epitheliomata involving the eyelid, such plastic operations have perhaps enjoyed less popularity than formerly and, if one recollects the miserable results obtained by the former conventional methods, it is not surprising that there should be a temptation to utilize X-ray, radium, and other methods of less proved efficacy. It must be borne in mind that the patients here presented have not only satisfactory eyelids, but can be presented after the lapse of years as cured of their epitheliomata, whereas at the present time no similar assurances can be given for the value of the competing methods.

LIGATION OF THE INNOMINATE ARTERY.

WITH REPORT OF A SUCCESSFUL CASE.

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Consideration of the infrequency of ligation of the innominate artery has led the writer to place upon record the history of the following case:

Mrs. K., aged sixty-eight years, referred by Dr. H. H. Webster, presented herself on January 11, 1913, complaining of severe pain about the right shoulder and in the right arm, and of a pulsating swelling above the clavicle.

She had always been a hard working woman, had not been addicted to the use of alcohol and there was no history of lues nor could there be found any evidence that there had ever been a luetic infection, though a Wassermann test was not made.

Her present trouble was noticed a month or six weeks before coming under observation, pain and difficulty in using the right arm being the first disturbance. Early in January, 1913, she detected the pulsating swelling.

Physical examination did not reveal any pathologic condition except a moderate arteriosclerosis and the enlargement above the right clavicle. The swelling, which was about the size of a hen's egg, presented all the characteristics of an aneurism of the subclavian artery. There was no apparent disturbance of the circulation in the arm, except the pain and certain paræsthesiæ; no evidence of nerve lesions beyond what could be accounted for by the pressure of the aneurismal sac on the brachial plexus.

She was at first treated by keeping her in bed, on a reduced diet, with limitation of the amount of liquid ingested and the administration of small doses of iodide of potassium.

On February 6, 1913, an attempt was made to insert fine silver wire into the sac; only about 8 inches of wire could be passed, however. This was cut off flush with the skin and has of course remained *in situ*.

No improvement in the local condition was effected and on February 10, 1913, she was operated upon, under ether anæsthesia.

An incision was made along the anterior border of the sternocleidomastoid down to the sternoclavicular articulation, and another one along the clavicle; the triangular flap of skin, superficial fascia and platysma was dissected up; after division of the deep fascia, severing the origin of the sternomastoid muscle and clearing away some of the loose fat, a good exposure of the aneurism and the deeper structures was obtained. The aneurism involved the third part of the subclavian artery, extending, however, behind the scalenus anticus muscle and encroaching upon the first part of the subclavian. It was accordingly deemed unsafe to apply a ligature to the first part of the subclavian and ligation of the innominate was decided upon.

The sternohyoid and sternothyroid muscles were severed and raised upward; about 2 inches of the clavicle were resected and the innominate artery was readily exposed. A heavy, braided double silk ligature was placed around this vessel, about ½ inch below the bifurcation, and tied with an ordinary surgical knot; as the knot was being tied the coats of the vessel could be distinctly felt to give way, though only very moderate force was used; evidently the vessel wall was markedly atheromatous. Pulsation of the sac at once ceased completely. The common carotid was also tied, about one inch above its origin, with No. 2 chromicized catgut. The wound was accurately closed, except for a small drainage opening at the inner angle, and the dressings so applied as to obliterate dead spaces. The arm was wrapped in cotton. The patient made no complaint of coldness of the limb subsequent to the operation, and there was no œdema or disturbance of the nutrition. The wound healed by first intention. There was at no time any evidence of disturbed cerebral circulation. The sac rapidly became consolidated and firm. Some pain and paræsthesia persisted for several weeks.

On June 29, 1913, it was noted that but little trace of the aneurismal sac could be felt; there was no pulsation of the radial or brachial arteries; the hand was colder than the left and the skin of the palm apparently smoother and somewhat atrophic. There was some pain about the end of the clavicle, probably due to the adherent scar.

The patient was examined thirteen months after the operation and found to be in good general health; her weight has increased, she works every day, and has no pain. No trace of the former aneurism can be felt, and the radial pulse is absent; there still seems to be some paræsthesia of the forearm and fingers. An examination of the chest fails to reveal any evidence of an aneurism of the arch of the aorta or any of its branches.

Observations on the blood-flow in the upper extremities were made by Prof. G. N. Stewart.[1] A note from him is as follows: "The blood-flow in both hands in Mrs. K. is greater on July 9, than at the previous examinations (March 20 and March 21). The ratio of the flow in the right to that in the left hand is 1 : 1.3 on July 9, while at the previous examinations it was 1 : 3.5. The relative increase has therefore been much greater in the right than in the left. Immersion of the left hand in cold water causes now a marked diminution in the flow in the right, indicating that an appreciable (and no doubt the greater) part of the total resistance of the path is now in the smaller vessels of the anterior limb. The arterial channels feeding the arm are therefore now comparatively wide. The flow in the right is absolutely as great (over 8 grammes per 100 c.c. of hand per minute with room temperature 26 C.), so that the symptoms now observed in the hand cannot be due to the small blood-flow."

As is well known, the innominate artery was first ligated by Valentine Mott in 1818. Sheen,[2] in 1905, collected 36 cases, including one of his own, and Burns,[3] in 1908, collected 10 more cases (one of them his own), bringing the number up to 46. I have been able to find references to the following additional instances: Myles,[4] one case unsuccessful, Saigo,[5] two cases (successful), Ballance,[6] two cases (one successful), Sargent,[7] one case (successful). These, together with my own case, bring the number up to 53, of which 14 were successful (26.4 per cent.). Only one of the recoveries, that of Smythe, dates from pre-antiseptic times. Tables are given by Sheen and Burns showing details of the cases up to 1908.

Allan Burns in 1811 demonstrated that the vessels of the head and the right arm could be fully injected after ligation of the innominate artery in the cadaver, and in looking over the published cases of the ligation of this vessel during life, no instances of gangrene could be found, though disturbance of the cerebral circulation occurred a number of times.

The most common cause of death has been secondary hemorrhage, which occurred in one instance as late as the sixtieth day after operation; this can be readily understood, as the majority of operations were done in pre-antiseptic days; however, secondary hemorrhage is still a large factor in the mortality record of the more recent cases.

The cases above referred to are, of course, very unequal in value for forming an idea as to the advantages and disadvantages of ligating the innominate artery and in deciding which plan of procedure is to be adopted in a given case. Most of the operations were done in pre-antiseptic times; the position and size of the aneurism was quite variable; in some a greater or lesser degree of arteriosclerosis existed; the ligature material varied; other vessels, such as the common carotid and vertebral, were frequently tied in addition; in two instances, at least, the aneurismal sac was extirpated after the ligation of the innominate for return of pulsation.

For the cure of aneurism of the right subclavian artery, which is the most common indication for the ligation of the innominate, some eighteen different operative procedures have been practised according to Jacobsthal[8]; to these may now be added the Matas method.

It is not the purpose of the present writer to discuss these methods. Cures have been accomplished by most or all of them, but it cannot be said definitely which is the method of choice. It may be noted that peripheral ligation has proven quite successful; Savariaud[9] has collected nine cases, all followed by recovery. It is the opinion of many writers that extirpation of the sac is the ideal method; both extirpation and the obliterative method of Matas are based upon the underlying principle, established by Antonio Scarpa, that the artery should be obliterated at the site of the aneurism. However, there are cases in which these methods can for some reason or other not be adopted and ligation of the innominate, which is now established as a feasible and reasonably successful operation, will have to be resorted to.

A few details in the performance of the operation may be briefly alluded to.

To gain access to the vessel, an incision along the anterior border of the sternomastoid, joined by another over the clavicle, has been the one most frequently adopted; the flap having been dissected up, the attachments of the sternomastoid are divided and also those of the sternohyoid and sternothyroid; the common carotid having been exposed, it is followed to its origin from the innominate. Ordinarily, the bifurcation is high enough to enable one to reach the vessel without removal of bone; however, excision of the inner part of the clavicle will materially aid in exposing the vessel and in giving more room for the deeper dissection. Milton [10] proposed longitudinal division of the sternum and forcible separation of the two parts in order to gain access to the anterior mediastinum; this seems to me an unnecessarily severe procedure, at any rate for ligation of the innominate. Bardenheuer recommended osteoplastic resection of the manubrium; the flap is hard to make, however, and is apt to suffer in its nutrition and necrosis may result. Removal of the right half of the manubrium and adjoining costal cartilages, and perhaps also the inner end of the clavicle, may be resorted to.

In clearing the artery injury to the innominate veins, the vagus and the pleura must be carefully avoided; and this is best accomplished by keeping close to the common carotid and innominate arteries and gently displacing the structures mentioned.

There has been considerable discussion concerning the character of ligature material to be used, the kind of knot to employ, whether to use two separate ligatures, a short distance apart, how firmly to tie them and whether or not the common carotid and other vessels should also be tied.

Provided rigid asepsis be maintained, it probably makes little or no difference what ligature material is employed; personally, I believe, that the ligature should be tied firmly enough to divide the inner coats and that the common carotid should also be tied, and perhaps the vertebral, as it is reasonable to assume that thus a return of pulsation in the aneurismal sac will be more likely avoided.

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[3] Journ. Amer. Med. Assoc., vol. xl, 1908, p. 1671.
[4] Dublin Journ. Med. Sc., vol. 124, 1907, p. 474.
[5] Deutsche Ztschr. f. Chir., Bd. 85, 1906, p. 577.
[6] Proc. Roy. Soc. of Med., vol. v, 1912, p. 99.
[7] Lancet, May 6, 1911, p. 1200.
[8] Deutsche Ztschr. fr. Chir., Bd. 68, 1903, p. 239.
[9] Revue de Chir., vol. iv, 1906, p. 1.
[10] Lancet, March 27, 1897, p. 872.

DISTANT RESULTS OF A SUTURE OF THE HEART FOLLOWING A WOUND BY PISTOL-SHOT.*

BY ROBERT PROUST, M.D.,

OF PARIS, FRANCE.

Four years ago I operated on a youth, fifteen years of age, for a wound of the heart.

He was able, after being cured, to return to his normal mode of living. Since the operation I have never lost sight of him, as he comes to see me regularly.

Lately, more than four years after the intervention, I have been able to examine with details, thanks to radioscopy, radiography and electro-diagnostics, the working of his heart. These are the results I shall have the honor to examine before you; but before doing so, I think it right to give you the details of this observation:

On February 20, 1910, being on duty, I was called at 5 o'clock in the afternoon for urgent service at the Trousseau Hospital, in Dr. Savariaud's ward, for a wound in the heart, diagnosis made by Messrs. Bloch and de Cumont, internes of the service.

On arriving, I saw a boy, thirteen years old, very tall for his age, who had been shot in the præcordial region. His condition was as follows:

At the beginning of the afternoon (at 10 minutes past 12 exactly), one of his little playmates had inadvertently pressed the trigger of a loaded pistol with which he was playing, and which fired at a distance less than one metre.

The blackish orifice, where the ball entered, is easily seen inside the nipple, and a rather wide streamlet of blood flows continuously from it. On auscultating, the beating of the heart is muffled but perceptible, the cardiac dulness seems to be enlarged at its basis. There is no sign of hæmothorax. Traube's semilunar space is sonorous.

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* Read before the American Surgical Association, April 10, 1914.

The pulse indicates about 100, but has a very bad tone, very unsteady in strength and rather undulating. The patient is extremely pale, in spite of numerous injections of serum and camphorated oil, of which the first were made by Dr. Gagnière, and which had pulled him through the great shock he had at the beginning; he is quite conscious, but is in great distress, a very acute dyspnœa, and intense thirst and a very great pain in which he called "the region of the heart." His physiognomy is imprinted with a striking anxiety. There are evidently symptoms which plead strongly in favor of a heart wound, especially the state of the pulse, but for once in a way it might be a question of simple shock. So, while everything is being prepared for the operation, I remain near the patient in order to closely appreciate the movements these divers symptoms are about to make.

After a rather long period of hesitation I have the impression of a progressive aggravation and decide on operation.

From the beginning I ascertain as far as possible the traject of the ball. For this, after having traced a cutaneous incision according to Fontan's rule, I lift the skin and soft parts along the border of the sternum, and find the fifth costal cartilage shattered by the ball; I raise it and come across a mass of liquid blood, which bubbles and is animated by beating, I then quickly complete the flap by sectioning the fourth and sixth costal cartilages at their sternal insertion. The turning down outwards of the flap simply by elasticity is quite easy since it is question of a thirteen years old boy. I am very careful in this turning down to unfasten and push back the pleura; it was wounded by the shot at the level of the præcordial part and the passage of the air is heard at each respiration, I cover with compresses this breach of which the walls are too infiltrated with blood to allow of suturing.

Ligature of the two ends of the internal mammary and the sectioned intercostals. I then cleanse the operative field, and after having sponged much blood and tamponed the lower part of the wound (where the blood comes from) I clearly see the forepart of the pericardium, and by transparence above it, the forepart of the heart which slides at each beating, but seems to be separated by a thin liquid sheet. I then take away the compress which tents the lower part of the wound, that is to say, the lower part of the pericardium. A spirt of blood is produced immediately and I clearly distinguish the wound in the pericardium from which it comes. I enlarge this wound with my scissors, both from the top and the bottom, to an extent of about 8 centimetres or about 3 inches, and mark the borders of the serous membranes with forceps after having isolated the operative field.

I am thus easily able to explore the pericardiac cavity, but at the level of the base I see only blood, and cannot distinguish the point of the heart. This is caused by the fact that all the base of the pericardium is filled with a *coagulum as large as the fist, which covers the point of the heart and compresses the heart upwards.*

I extract the coagulum, and with it the ball which was free in the pericardium. As soon as the coagulum is taken away the point of the heart appears freely with its pinkish white color; there is clearly distinguished a wound in the front residing near the left border quite near the point; a jet of blood escapes from it at each systole. Moreover, from the moment the coagulum is taken away, the heart begins to beat in a most immoderate manner, and it is with great difficulty that it is grasped. I am moreover troubled by the stock of instruments, for, at the beginning, I have at my disposal only a curved Reverdin's needle of the current model. It is with this that I quickly make my first stitch which perforated totally the wall of the heart; once knotted it stops the hemorrhage a little, but blood escapes along the thread. From this first stitch I am able to make three others non-perforating, by using this time the small Reverdin's intestine needle. I hide the first set of transversal sutures by a second plan of superficial sutures. I then turn the heart upwards to look for a second wound on the posterior face but I find none. But seeing the descendent obliquity of the traject of the ball, I come to the conclusion that it is a tangential wound although a penetrating one.

Suture of the pericardium with separated stitches of catgut No. 0: the lowest stitch fixes a very small rubber drain, which is level with the serous membrane and even penetrates into it at a little less than a centimetre; the drain has a vertical traject and comes out again in the lower horizontal branch of the cutaneous incision near the sternum. This drain was used on account of the relatively long time between the accident and the operation, and also on account of the finding of the bullet in the pericardium.

The flap is turned back (without suture of the pleura, which I find too infiltrated), and as I fear the edge of the lowest rib might wedge the drain, I protect the latter with a little tent of about 3 centimetres long, not going so far as the pericardium.

Reunion of the muscular surface with catgut. Fish-gut for the skin. Subcutaneous serum during the whole of the operation.

Operative Consequences.—Immediately after the operation the patient is taken back to his bed, in appearance hardly the worse for the operation.

The next day, February 21, there is a considerable thermic reaction. In the morning 39.8° Centigrade, that is about 103.6° Fahrenheit, and in the evening 40.4° Centigrade, or about 104.8° Fahrenheit.

In spite of this the general status is not alarming, the pulse indicates 110.

The following days there is a slight fall in the temperature which, however, remains very high.

On the ninth day, ablation of the small tent joined to the drain; immediately after this follows the escape of a reddish serosity, non-purulent, and of which the rhythmical flowing is isochronal to the cardiac beating (at this moment the temperature is about 102°, but the general status, which remains good, continues to disagree with this temperature).

Pulse indicates 96.

March 2 and 3.—Same status.

March 4.—The oozing tinged with blood which followed the ablation of the tent has stopped, the patient has a little chill, and in the evening the temperature is 104°.

March 5.—Messrs. Proust and Perinaud examine the patient in the evening; the pulse is very undulating, of very feeble tone and indicates 120. The heart-beats are exceedingly dull on auscultating, the patient has some trouble in swallowing, which has increased since the operation. Briefly, there are evident signs of pericardiac effusion. The small rubber drain, however, produces nothing. It is still solidly fixed in the depth and oscillates with the cardiac movements; I pull it away with a sharp tug and immediately out flows a great abundance of blood-stained serosity which is in no way purulent. The hand which palpates the radial pulse feels that little by little it puts itself right from this moment. It becomes pronounced, excellent, very strong.

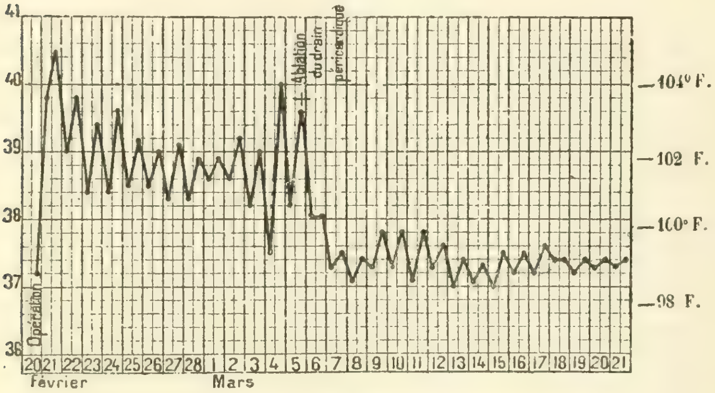
From this moment the effervescence begins to cease, and finishes in less than 48 hours. The patient leaves the hospital on March 21, 1910, cured, one month after the operation.

Examination on leaving the hospital: Temperature normal, pulse 80, the beating of the heart seems normal, the troubles of swallowing have totally disappeared as well as the rising of the stomach which attended them.

The patient was presented at the Société de Chirurgie at Paris on April 13.

Immediately after his departure from the hospital, on March 21, 1910, he was engaged as telegraph messenger at the Post Office in Paris, and able to return to his normal mode of living.

Fig. 2.

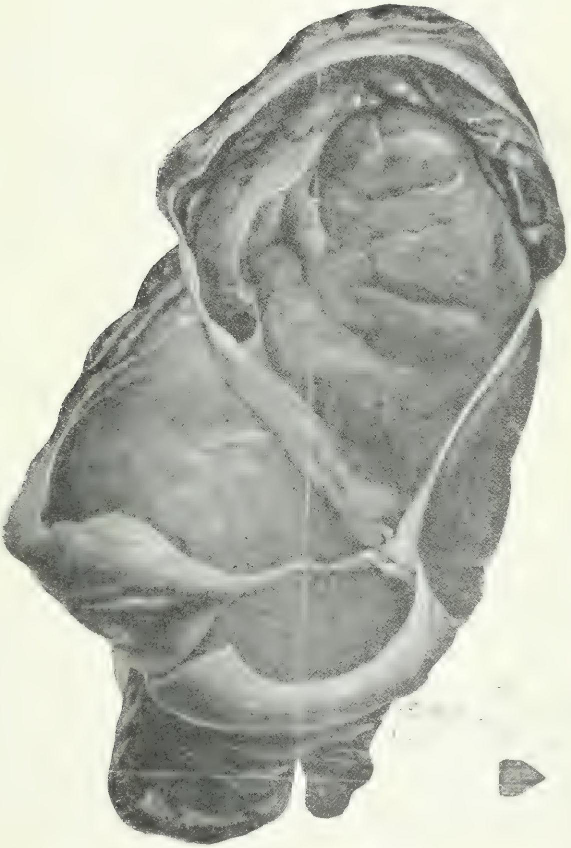


Graphic.

He followed this calling of telegraph messenger during three years, and in spite of the fatigue experienced in climbing long staircases, he did not show any functional cardiac troubles; at the most did he notice, in the beginning, a little panting after hurrying upstairs. Since a year ago he has changed his profession. He is now a book-keeper and complains of no trouble whatever. Having his address I asked him if he would be examined in order to see if, a long time after the operation, our means of investigation would show, in spite of the total absence of functional disorders, anything abnormal, either at the level of the cardiac suture properly speaking, or as remains of the pericarditis he had shown.

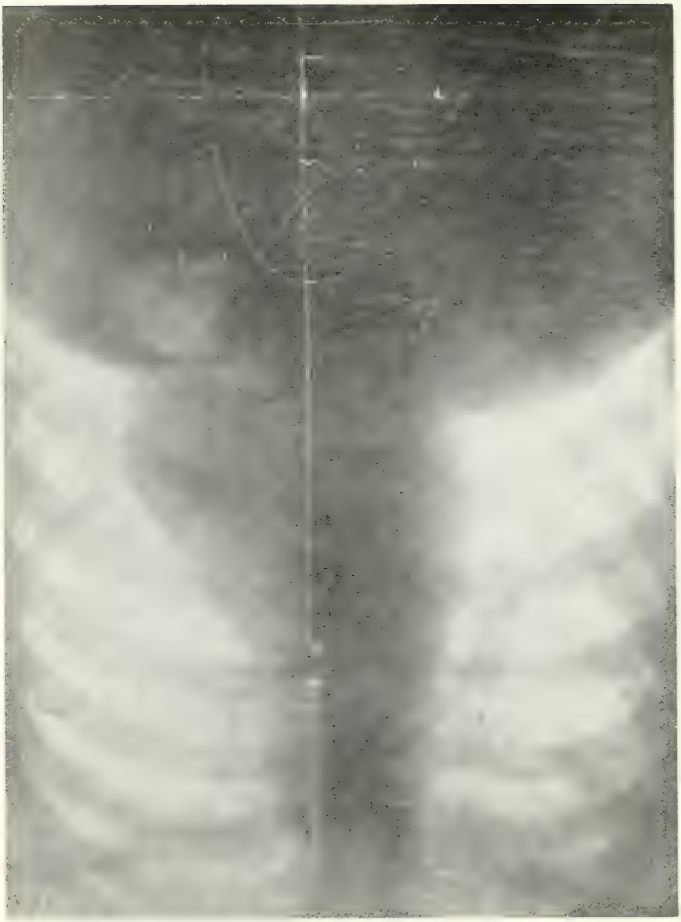
With this aim I asked my colleague and friend Dr. Bezaçon, chief physician at the Charity Hospital, to be good enough to consult him; Dr. Aubourg, chief of the Radiology Service at the Boucicault Hospital, to kindly radiograph him; Dr. Bourguignon, chief of the Laboratory of Electricity at the Salpétrière Hospital,

Fig. 1.



Intrapericardiac clot and bullet extracted from the pericardium.

Fig. 3.



Radiograph.

to be kind enough to trace out his pulse, and Dr. Boulle, chief at the Marey Institute, to be kind enough to take his electrocardiogram.

The auscultation and electrocardiogram have established that the working of the heart was almost normal. But the point of the heart seems a little too near the sternum and the electrocardiogram shows a double bracket at the time of the ventricular contraction. The radioscopic examination has shown us very slight modifications consecutive to the sutures.

Here are the notes kindly provided to me by Dr. Aubourg:

Radiologic Examination.—The examination of the frontal region of the heart shows:

The left auricle has a normal aspect and volume.

The right ventricle has also a normal aspect.

The part of the left ventricle which forms the left border of the heart presents a normal shape; at the union of the external 2/3 and the internal 1/3 of the left border at the height of the fifth rib, is seen a permanent notch, which seems to be a fixed point which does not participate in the beating of the left border, as if at this level there were something which restrains the left border, such as retracted adherence. Moreover, below this notch, is seen, on the left ventricle itself, a circular zone of ¾ inch diameter, and which, by its clearness, shows up on the deep color of the remainder of the ventricle.

Afterwards, on practising divers oblique examinations, in order to judge the status of the left auricle and the posterior part of the left ventricle, it is seen that these cavities are neither deformed nor dilated.

The nature of the mark seen on the forepart is interesting to note; this might be an adherence of the pericardium, but one would not understand why the subjacent myocardium should not have preserved its thickness; so I believe it is question of an abnormally thin state of the myocardium following a scar, for example.

The second part of the examination bears on the œsophagus; the patient is placed in an oblique position, in order to distinctly see the clear space which exists between the vertebral column, the aorta and the heart.

The patient has absorbed a milk of carbonate of bismuth; the bismuth has designed an œsophageal duct of normal aspect as far as the origin of the large vessels. From this place, as far as the diaphragm, that is to say, over nearly four inches, we have seen a diminution of size of the duct, which can be estimated at a half of the normal calibre. When the bismuth got to the cardia we ascertained antiperistaltic movements several times and these movements are caused by a parietal lesion of the œsophagus. These are two objections against the supposition of a lesion of the internal tunic: first, the absence of dilatation above the stricture; second, the regularity in the diminishing of light, whereas in the lesions of the internal tunic there exists an essentially irregular canal.

We may, therefore, think that it is question of lesions of the external tunic, perhaps by adherences to the pericardiac pouch in relation with the auricles.

What does this examination prove?

That there incontestably remains some œsophageal troubles connected with pericarditis and that, on the other hand, there persists either a slight weakening of the cardiac wall at the level of the scar, or perhaps a pericardial adherence at this level.

These declarations obtain their value from the agreement of the two phenomena observed by Dr. Aubourg: first, the œsophageal troubles and the cardiac zone being lighter and more immovable, corresponding to the troubles of swallowing that the patient had experienced after the operation; second, to the precise passage of the bullet which had shattered the fifth costal cartilage.

The radioscopic ascertainings have indeed been established by Drs. Aubourg and Lebon, who were absolutely ignorant of the exact level of the wound in the heart and the troubles in swallowing that the patient had experienced after the operation.

Pericarditis continues to be the great obstacle to the perfect cure of wounds of the heart. In this particular case I willingly attribute its origin to the sojourn in the pericardium, during a prolonged time before the operation, of the bullet, which, it appears, not having a very considerable speed, might easily have got contaminated from the contact of the clothes or dragged a particle of dirt with it. It was, in any case, a very attenuated pericarditis, because the serosity was in no way purulent and the simple evacuation brought about the cure.

Although not a partisan of drainage in heart wounds, I believe that in this particular case, the fixing of a small rubber drain in the very orifice of the pericardium enabled us, if not by its presence, since it disappeared immediately, at any rate by its ablation, to obtain the result which would not have been obtained without it, except by a paracentesis of the pericardium. I believe there would be great interest in submitting to radioscopic and radiographic examinations patients who have been operated on for heart wounds, and by such, we shall get to know in precise manner the exact value of distant results.

A REVIEW OF NINETY-NINE ARTHROTOMIES FOR FRACTURE OF THE PATELLA.*

BY H. BEECKMAN DELATOUR, M.D.,

OF BROOKLYN, N. Y.,

Surgeon to the Norwegian and to St. John's Hospitals.

TWENTY years ago our societies were discussing the justification of the open operation for fracture of the patella much as we are to-day considering the operative treatment of fractures of the long bones. It was then argued that the dangers of a stiff joint following the operation were so great that a patient had better accept a partially crippled joint with ligamentous union of the patella than to risk a stiff knee following the operation.

No less an authority than the late Dr. William T. Bull took this ground. Surgeons generally are now agreed that immediate operation on the patella is entirely right and proper, but we are still divided in regard to the other fractures.

If we can convert a simple fracture of the patella into a compound one and at the same time expose the great knee-joint filled with fluid and clotted blood, without great risk, why should we hesitate to expose other fractures? The answer is, that in the treatment of the long bones we are influenced not by the fear of sepsis, but rather by the knowledge that satisfactory bony union, without operation, so generally results. The patella we know seldom can heal by bone because of the frequent interposition of fascia between the fragments.

As having some bearing on the question of the dangers of exposing fresh fractures to operation, I herewith present a review of cases of fracture of the patella, personally observed by me. The majority of the cases were operated by myself, while some were operated by my associates in the hospital service.

There were 101 fractures of the patella, and, with two exceptions, they were all subjected to the open operation.

One exception was a young woman of twenty-three, in whom, by indirect violence, the left patella was fractured transversely. After the accident she was able to stand, but not to walk. In this case the patient was very thin, the two fragments could be distinctly felt, and crepitus could be easily elicited. The separation of the fragments was very slight. We felt that in this case the tendinous expansion of the vasti muscles had not been torn and that there was a fair chance for good union. There was also decided opposition on the part of the family to operation. The limb was placed on an inclined splint and the fragments held together by adhesive plaster placed about the fragments. The result was very satisfactory. A year later the opposite patella was broken, and although the separation of the fragments was greater, operation was not performed because of objection by the family. In this case the result was satisfactory, although at the end of six months there was some separation of the fragments, about half an inch. A year later this had not increased. She was able to walk perfectly well without aid. Seven years later the condition had not changed.

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* Read before the American Surgical Association, April 10, 1914.

The other was a man over seventy years of age, who obtained a satisfactory result from similar treatment.

The operation has been performed within the first 48 hours after the injury, except in a few cases in which it has for various reasons been delayed to a later period. The operation has not varied except as to the skin incision. At first we made a straight longitudinal incision over the centre of the knee, but found that it did not give quite as good access to the lateral tears as did the curved incision across the joint. Our incision now begins on the inner side just posterior to the centre of the inner half of the knee and on the line of the joint, and is carried upward in a curve, passing about half an inch above the patella and then downward to the outer side of the joint to a point opposite the beginning. The flap includes the skin and all structures down to the patella tendon. This flap is dissected down to below the lower edge of the patella and gives a good exposure of the fracture and of the joint, and also what we consider most important, of the tear extending down on either side of the joint through the tendinous expansion of the vastus muscle. This tear is caused, in most cases, by the patient's efforts to walk after the patella has broken.

After all clots and fluid blood have been carefully sponged away, the fractured ends of the bone are thoroughly freshened and exposed by dissecting off that portion of the patella tendon which has dropped down and become adherent to the rough ends of the fragments. This we have never failed to demonstrate. We use for sutures chromic catgut No. 2. The first sutures are placed close to the edges of the fracture on either side. These are not tied until the rents in the lateral portion of the capsule have been accurately repaired. The first sutures are then tied so as to bring the posterior edges of the fracture together. If, when these sutures are tied, the anterior edges are separated by an eighth of an inch or more, we are better satisfied because then we are sure that the tying of the anterior sutures will surely give closer apposition of the fragments. The next suture is a sort of mattress suture. It is placed crosswise through the patella tendon above the upper fracture and then carried across the tendon below the lower fracture and tied. The effect of this is to take the strain from the transverse line of sutures during the recovery from the anæsthetic, when the great quadriceps muscle contracts. A final row of sutures is placed in the anterior layer of the tendinous expansion over the bone; the skin sutured with interrupted silk-worm-gut or continuous silk sutures. No drainage is employed.

The extremity from the toes to the upper thigh is placed in a plaster cast. This splint is left in place for ten days; it is then cut down on either side and the anterior half removed, leaving the posterior half as a permanent splint. At this time the sutures are removed and the patella grasped between the fingers and moved laterally. This movement of the patella is repeated every four or five days until the end of the third week, the patient being allowed in the wheeled chair after the second week. At the end of three weeks the cast is again removed and passive motion begun in the joint. The splint is then removed every night while the patient is in bed and reapplied in the morning. This allows of passive motion on the part of the patient when there can be no strain on the callus. If the patient resists the efforts of moving the joint to at least 45 degrees by the end of the second month, he is given an anæsthetic and under complete muscular relaxation the joint is forcibly bent to a right angle. There need be no fear of refracture in doing this, provided complete muscular relaxation is first obtained. This procedure is usually successful in bringing back a rapid return of the motion of the knee.

We advise our patients to use the posterior splint while walking for at least three months. After the second month while sitting in a chair we encourage them to have the splint removed and allow the leg to bend as much as possible.

In a few cases where the patient was exceedingly muscular we have used silver wire, believing that it would be better able to stand the strain of the muscular pull when the patient was recovering from the anæsthetic. In this we have been disappointed, for in two cases X-rays taken shortly after the operation showed the wire broken. We now use the mattress suture in the tendon, as above described, with satisfactory results.

In one case of refracture in a very muscular man, we made use of the Malgaigne hooks to hold the bone during the first week. In this case separation was quite wide and the hooks were found a very convenient way of bringing the fragments together and holding them during the suturing.

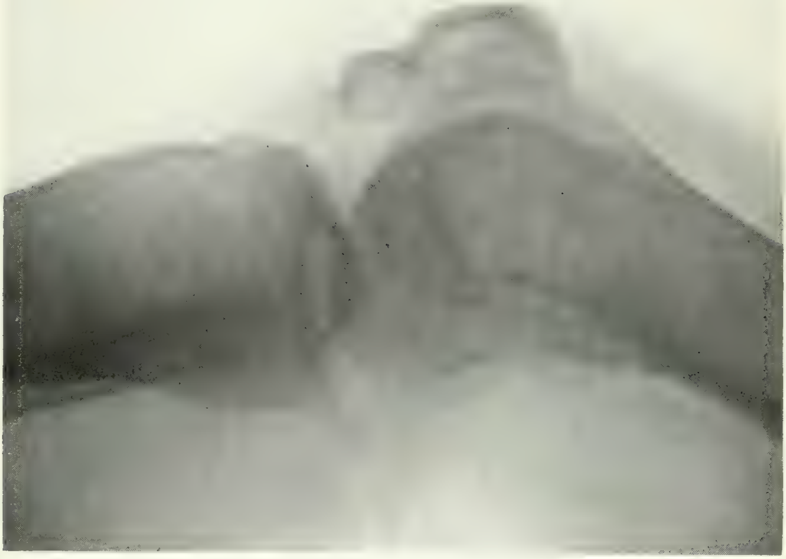
The following is a summary of our cases:

No. of patients.	Variety of fracture.	No. of fractures.
72	Simple of one patella	72
3	Compound of one patella	3
3	Simple of both patellæ at the same time	6
3	Simple of both patellæ at different times	6
2	Simple of the same patella twice	4
2	Simple of the same patella three times	6
1	Simple twice and compound a third time of same patella	3
1	Simple of both patellæ at different times, with refracture of one	3
87		103

There were 99 operations. All recovered from the operation. Two died while in the hospital, one on the twenty-first day of delirium tremens and one on the one hundred and twenty-seventh day of pulmonary tuberculosis. In both cases the anatomical result of the operation was satisfactory.

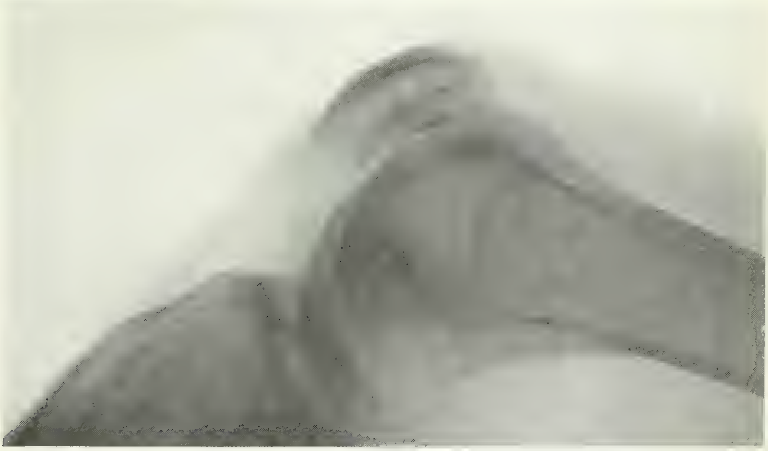
A number of the fractures were multiple, the bone being broken in from three to six fragments. This did not seem to make any difference in the result.

Fig. 1.



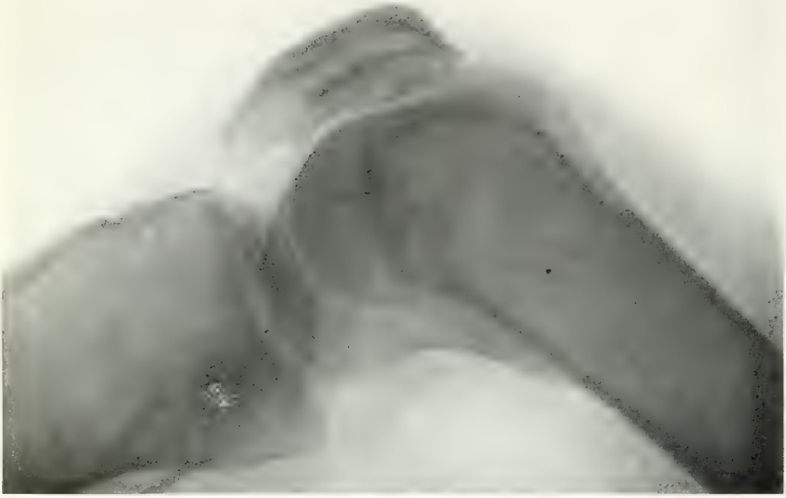
Left knee. Operated July, 1912. Useful joint, but flexion not to right angle.

Fig. 2.



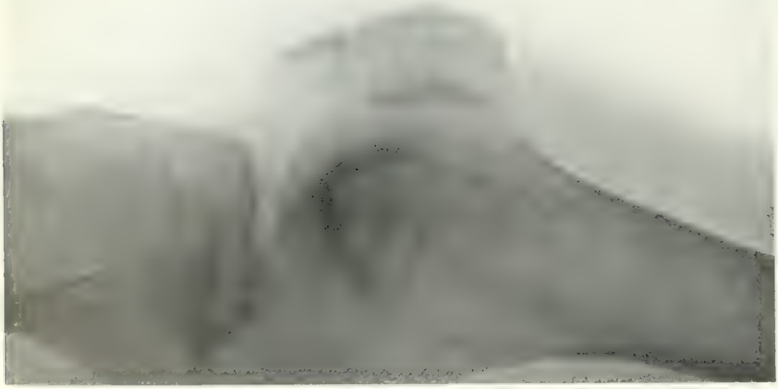
Left knee. Operated March, 1911. Rheumatic patient, but by persistent massage good flexion was obtained.

FIG. 3.



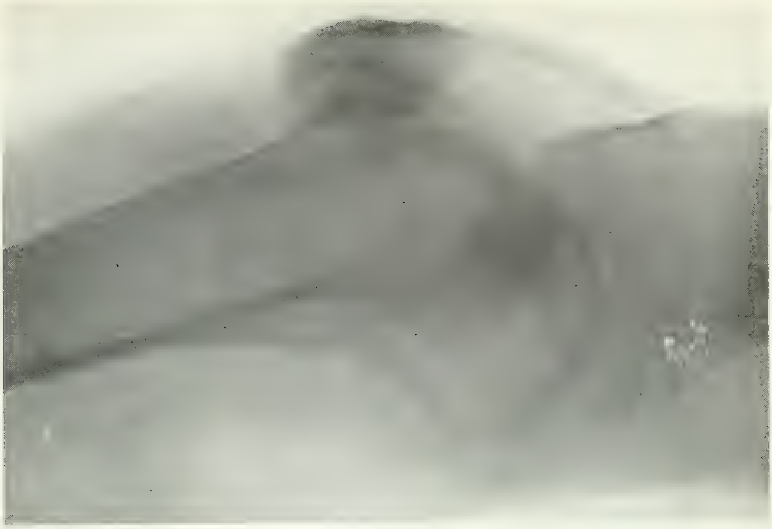
Left knee, operated August, 1909. Function of knee normal.

FIG. 4.



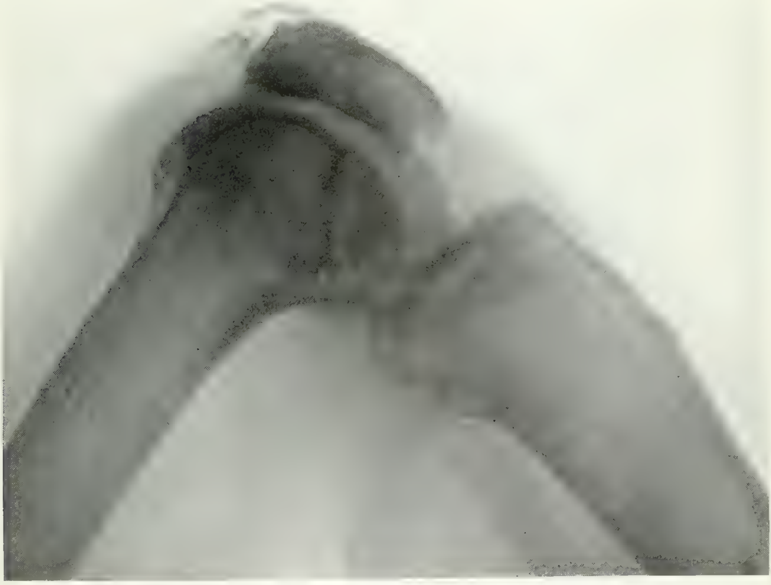
Comminuted fracture. Operated January 14, 1911. Good union. Motion still limited but improving.

FIG. 5



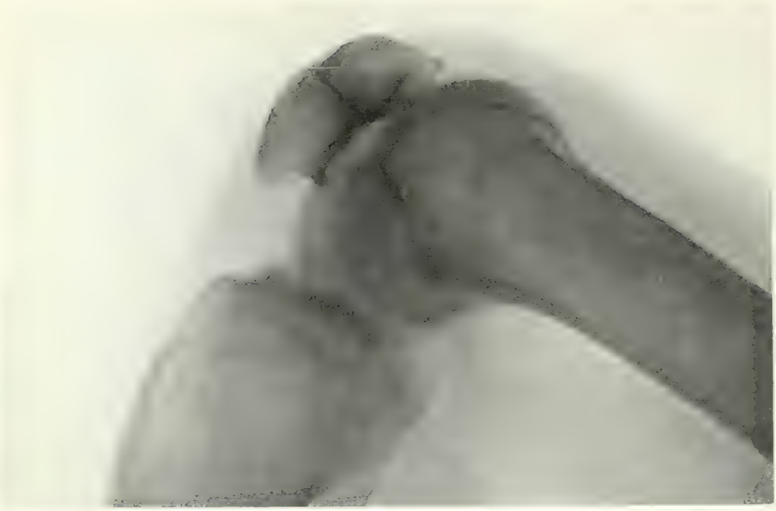
Left knee. Joint motions good. The angle at which picture was taken gives an apparent distortion of joint.

FIG. 6



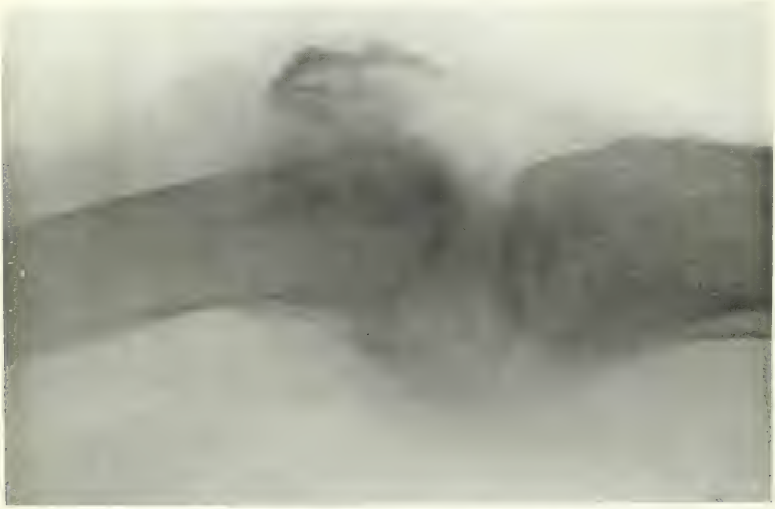
Right knee. Operated November, 1912. Perfect function. Simultaneous direct fracture of both patellæ, with fracture of fifth cervical vertebra and paralysis of left arm (see Fig. 7).

FIG. 7.



Left knee. Operated November, 1912. Perfect function. Simultaneous direct fracture of both patellæ, with fracture of fifth cervical vertebra, and paralysis of left arm (see Fig. 6).

FIG. 8.



Operated February 14, 1913. Good [illegible]. Motion in joint just begun.

There have been three cases of simultaneous fracture of both patellæ. In two the operation was done first on one side and later on the other. In one both patellæ were sutured at one sitting. This case was particularly interesting because it was a case of direct fracture, the man being thrown from a step-ladder by an electric shock. One patella was broken into five fragments and the other into three; the patient also sustained a fracture of the spine of the fifth cervical vertebra with resulting paralysis of the left arm. He made a perfectly uneventful recovery, and at the present time, 16 months after the operation, is able to get about as well as ever and to bend the knees to beyond a right angle.

In the cases of refracture, there had evidently been perfect bony union, for at operation the point of previous fracture could not be made out. In two cases we did not secure bony union, but in these there has been no tendency for separation of the fragments.

An interesting case was as follows: A very muscular man of 40 was brought to us with a fracture of the right patella. Eight years before this bone had been broken and successfully sutured by the late Dr. Bristow. In May, 1913, we resutured this bone and obtained an excellent result. He resumed his occupation the following August and was seen in September, when he had perfect motion in the joint and the knee looked normal except for the two scars. Three weeks later he was again brought to the hospital with a refracture of the same patella, the joint being badly infected. Drainage was instituted, extension applied, but the infection progressed and the femur and tibia both became involved. The process was finally terminated by an excision. This leaves him with a stiff joint, the only one we have in our series.

SUMMARY OF CASES TREATED FROM 1896–1914.

There were 87 patients with 103 fractures. Three cases were not operated, one refused treatment and was removed home. There were 2 deaths, neither directly due to operation. In 99 instances the fracture was exposed and sutured. Six have useful joints but with limited motion. Forty have flexion to at least a right angle and have perfectly useful joints. The remainder we have not been able to trace; all had motion to at least 45 degrees at the time of leaving the hospital, and in our experience this has always been followed by satisfactory motion if the patient persists in his efforts to move the joint.

THE NEW DRESS OF THE ANNALS.

ANNOUNCEMENT FROM THE PUBLISHERS.

OWING to the continually increasing amount of material of value, offering for publication in the ANNALS OF SURGERY, the publishers have found it necessary beginning with the July 1914 issue to enlarge the size of the page and also to somewhat reduce the size of type in which the original contributions have heretofore been printed. The enlarged size will also enable the publishers to make a better display of the illustrations which are such an important feature of the ANNALS OF SURGERY'S contributions.

Thirty years ago, when the first number of the ANNALS OF SURGERY appeared, the size and style then shown suited admirably. At that time a single number contained only 96 pages. They have continued to increase each year until now the average number of pages to an issue is 164. Special issues have been published in which the number has been increased to over 300 pages, with the result that the manufacturing of the Journal in the former style is not only extremely difficult but the finished product is unwieldy and cannot be read with the ease and comfort which is due a subscriber. In fact, it required constant pressure on the pages to keep them open.

We believe the new form overcomes this inconvenience and enables us to give the reader more material and greater comfort while reading than it could have been possible for us to present in the former size. THE PUBLISHERS.

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